

EXECUTIVE SUMMARY

Purpose of Survey

The Washington State Department of Transportation (WSDOT) contracted with ECONorthwest (ECO) to conduct a survey of Hood Canal Bridge users to determine trip patterns, frequency, and purpose. The eastern half of the floating bridge was constructed in 1961 and is nearing the end of its structural life. The severe marine climate, accelerating deterioration, drawspan unreliability, and a desire to bring the bridge up to higher standards makes the east half of the Hood Canal Bridge one of WSDOT's highest priority bridges. Repair of the east half of the bridge in the year 2004 will require closure of the bridge for six to eight weeks. The information in this report will help WSDOT determine how to mitigate the effects of the bridge closure on the users of the bridge.

ECO served as the prime contractor on a team with Transformation Systems, Inc., and Pacific Rim Resources. The consultant team gathered and analyzed data from daily traffic counts provided by WSDOT, vehicle registration data obtained through a video survey of license plates, and the results of a mailed questionnaire regarding trip origins and destinations.

Key Findings

ECO's analysis of Hood Canal Bridge traffic reveals three major factors that WSDOT should consider when planning for the bridge closure. First, weekend traffic volume is higher but less patterned than weekday traffic. Second, the communities adjacent to the bridge generate more than half of all bridge traffic. Third, trip purpose determines many characteristics of bridge use.

- **Weekend traffic averaged 18,759 vehicles per day, almost 4,000 more vehicles per day than the weekday average of 14,915.** Daily traffic counts provided by WSDOT show that during the survey period, an average of 17,221 vehicles used the Hood Canal Bridge each day. Weekday traffic peaks for eastbound traffic in the morning and for westbound traffic in the evening. Weekend traffic does not exhibit a distinct pattern, but it remains consistently high from mid-morning through late evening.
- **Vehicles registered in ten cities near the bridge accounted for 41% of all trips made during the survey period.** The videotape survey of license plates identified over 36,000 license plates during the survey period, of which almost 30,000 were matched to registered owners. According to the origin/destination survey results, the vast majority of traffic over the bridge originates from or ends in the Port

Townsend, Port Ludlow, and Sequim/Port Angeles areas on the west side of the bridge and the Poulsbo/Kingston and Bremerton/Port Orchard areas on the east side of the Hood Canal Bridge.

- **Origin/destination survey results show that trip purpose correlates with frequency of travel over the bridge and the ability of travelers to reschedule their trips.** Travelers whose trip purpose was travel to or from work made up 33 percent of weekday traffic. Of the 33 percent, 30 percent use the bridge five or more times per week in the direction identified, and 13 percent say they are unable or unwilling to reschedule their travel if the bridge closes. Leisure travelers comprised 61 percent of all traffic volume over the bridge on weekends. The majority of these travelers (64%) use the bridge once a week or less, and 36 percent are willing to reschedule their travel if the bridge is closed.

Implications for Mitigating Effects of Bridge Closure

The three major factors affecting the volume and flow of the traffic on the bridge – the day of the week, proximity of the user to the bridge, and trip purpose – should be primary considerations in designing strategies to mitigate the effect of the six- to eight-week closure of the bridge. More than any other topics studied, these three factors determine how the bridge is currently used, and they will affect the use of alternatives when the bridge is closed.

The origin/destination trip tables show consistent travel patterns to and from the cities and towns in closest proximity to the bridge: Port Ludlow, Port Townsend, Sequim, Port Angeles, Kingston, Poulsbo, Bremerton, and Port Orchard. Whatever alternatives are made available should focus on linking these communities. The traffic patterns and volumes from these areas are generally similar on weekends and weekdays. The total average weekend volume of 18,759 vehicles per day is significantly higher than the weekday average of 14,915 vehicles per day. WSDOT may need different strategies to accommodate the higher traffic volume on weekends.

Because the additional weekend volume consists largely of leisure travelers making discretionary trips, however, any difference between weekend and weekday volume will be lessened by the number of travelers who choose to defer their trip. If these leisure travelers opt to avoid trips during the closure, the potential congestion on any alternative routes will decrease but at a cost to the business owners near the bridge who rely on tourism as a major component of their business. The economic impact to the areas near the bridge is also a consideration when planning for the bridge closure.

Commuters traveling across the bridge to and from work are the least likely to defer their trips. This group indicated that they use the bridge an average of five times per week in the direction identified on the survey. Only 13%

said they would be willing or able to reschedule their travel, so they will be affected significantly by a bridge closure.

Whatever alternate strategies are provided will need to accommodate the bridge's primary users: drivers traveling to and from the communities in the immediate vicinity of the bridge. Alternatives will need to account for the higher weekend traffic volume as well as provide service for the weekday work commuters who use the bridge most often.

Survey Methodology

This analysis of bridge traffic includes data from three main sources: daily traffic counts collected by WSDOT; vehicle registration data gathered during the automated video license plate survey; and results of the mail-in origin/destination survey sent to registered owners of vehicles identified in the video survey. Together these three sources provide data on traffic volume and flow, vehicle registration locations, and the origins and destinations of bridge users.

The automated video license plate survey was an integral component of the overall bridge study. The video survey took place on Friday, June 5, through Sunday, June 7, and Tuesday and Wednesday, June 9 and 10, 1998. Transfo Systems, Inc., (Transfo) installed and staffed two video cameras located in the center drawspan of the bridge where they recorded a total of 36 weekend hours and 36 weekday hours of both eastbound and westbound traffic.

Quick and accurate data handling from the time of video capture through the survey mailing was critical to the success of the project. With close coordination and rapid transfer of data files, the consultant team was able to process and mail most surveys within two to three days of travel across the bridge.

The consultant team mailed 18,000 origin/destination surveys, and recipients returned 7,000 surveys, a 39 percent response rate. The survey questions address the origin, destination, and purpose of the trip; the frequency of bridge use; the number of people in the vehicle; and the vehicle type. One question pertains to the use of ferries, and one question relates to alternate routes that could be used if the bridge were closed. The bottom third of the survey contains a map of western Washington, divided into 28 zones. The survey recipients used the zones specified on the map to code the starting and finishing points of the one-way trip identified by the trip information printed on the survey form.

The response rate of 39 percent is very high for mailed surveys. The high response rate indicates that the surveys reached the appropriate audience in a timely manner, that the survey recipients have a strong interest in the

future of the bridge, and that they are willing to contribute to the planning of alternate transportation strategies.

The sample size of 7,000 is large for surveys of this type and generates statistically valid results regarding the existing patterns of use and trip purpose. It is important to remember that the survey data reflect the existing uses of the bridge. The temporary closure of the bridge will substantially alter the relative costs of making a trip across the Hood Canal during that period. These changes in travel costs could significantly change the patterns of trip making during that period. While it is important to understand the existing patterns of bridge usage, any strategies to mitigate the effects of the bridge closure should account for how travelers will likely respond to those future conditions.

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1 PROJECT OVERVIEW

HISTORY OF THE HOOD CANAL BRIDGE

The Hood Canal Floating Bridge, the William A. Bugge Bridge, opened on August 12, 1961. On February 12-13, 1979, the west half of the bridge sank in a storm, and the bridge was closed for over three years until work to replace the destroyed half was completed in October 1982. The Washington State Department of Transportation (WSDOT) recently completed a review of the east half of the bridge, the portion that was not replaced in 1982.¹

The WSDOT study focused on bridge condition (deterioration), drawspan operation (reliability), and risk of major storm damage (structural capacity). The report's findings show that the bridge is deficient in all three areas. The east side of the drawspan, which should open to 300 feet, started jamming at 200 feet in 1996; it has been corrected to only 260 feet. According to the study, "the risk of critical damage due to major storms, in itself, is sufficient cause for replacement of the east-half."

In light of these deficiencies, WSDOT is planning to replace the east half of the Hood Canal Floating Bridge. The purpose of the replacement is to maintain the existing transportation link while minimizing the costs incurred by the state and the users of the facility. The bridge will be closed to all traffic for six to eight weeks in the year 2004 while construction takes place. WSDOT is beginning the public involvement process to obtain input from bridge users regarding the timing of the closure and to solicit ideas regarding potential strategies to mitigate the effects of the closure.

SURVEY BACKGROUND

WSDOT contracted with ECONorthwest (ECO) to conduct an origin/destination survey of travelers using the bridge to analyze the demand for alternative strategies during the bridge closure. ECO served as the prime contractor for this project and worked closely with Transformation Systems, Inc., (Transfo) and Pacific Rim Resources (PRR).

The analysis of bridge traffic includes data from three sources: daily traffic counts gathered by the Washington State Department of Transportation, vehicle registration data collected during the automated video license plate survey, and results of the origin/destination survey mailed to vehicle owners identified in the video survey. Together these three sources provide data on traffic volume and flow, vehicle registration locations, and the origins and destinations of bridge users.

¹ *William A. Bugge Bridge Replacement Plan for the East-Half Floating Portion* report by the Environmental and Engineering Service Center Bridge and Structures Office.

WSDOT provided daily traffic counts that show total facility usage by vehicle class, which ECO used to compare the traffic flows and volume patterns of weekend traffic to weekday traffic. Based on this data, ECO also determined number of commercial vehicles using the facility at different times of day.

The video survey involved videotaping the license plate numbers of vehicles using the Hood Canal Bridge and matching the license plates with information on owner registration from the Department of Licensing's database. ECO used the registration information to determine the cities and towns that will be most affected by a bridge closure.

To obtain information on the origins and destinations of bridge users, the consultant team mailed surveys to the drivers of vehicles identified during the video survey. The survey was designed with a tear-off panel that ensured the confidentiality of the response. The survey confidentiality, a two-day turnaround on the mailing of the survey, and the high degree of community interest in the bridge contributed to a very high response rate. Nearly 40 percent of those who were mailed a survey completed it and mailed it back. The results of the survey provide essential information regarding the traffic flows on the bridge and indicate which routes will be most affected by the closure.

2 SURVEY METHODOLOGY

AUTOMATED VIDEO LICENSE PLATE SURVEY

During the first half of June 1998, Transformation Systems installed video cameras in the center drawspan of the Hood Canal Bridge to record the license plate numbers of vehicles using the facility. The cameras continuously recorded the vehicle license plate numbers of all eastbound and westbound traffic for a total of 36 weekend hours and 36 weekday hours. Videotaping was completed between Friday, June 5, and Wednesday, June 10, 1998. Table 2.1 shows actual taping times.

Table 2.1 Videotaping Schedule

| Date | Day | Start Time | End Time | Hours Taped |
|---------|-----------|------------|----------------------|-------------|
| June 5 | Friday | 2:00 pm | 8:00 pm | 6 |
| June 6 | Saturday | 7:00 am | 11:00 pm | 16 |
| June 7 | Sunday | 8:00 am | 10:00 pm | 14 |
| | | | Weekend Total | 36 |
| June 9 | Tuesday | 7:00 am | 12:00 am | 17 |
| June 10 | Wednesday | 12:00 am | 7:00 pm | 19 |
| | | | Weekday Total | 36 |
| | | | Overall Total | 72 |

DATA TRANSFER

Transfomation used 74 video cassettes during the taping, with each tape representing two hours of continuous filming for one direction of traffic. (Four tapes were only one hour in length to divide two calendar days). Each evening, Transfomation sent all completed videotapes to Computer Recognition Systems, Inc., (CRS) in Cambridge, Massachusetts, via overnight delivery.

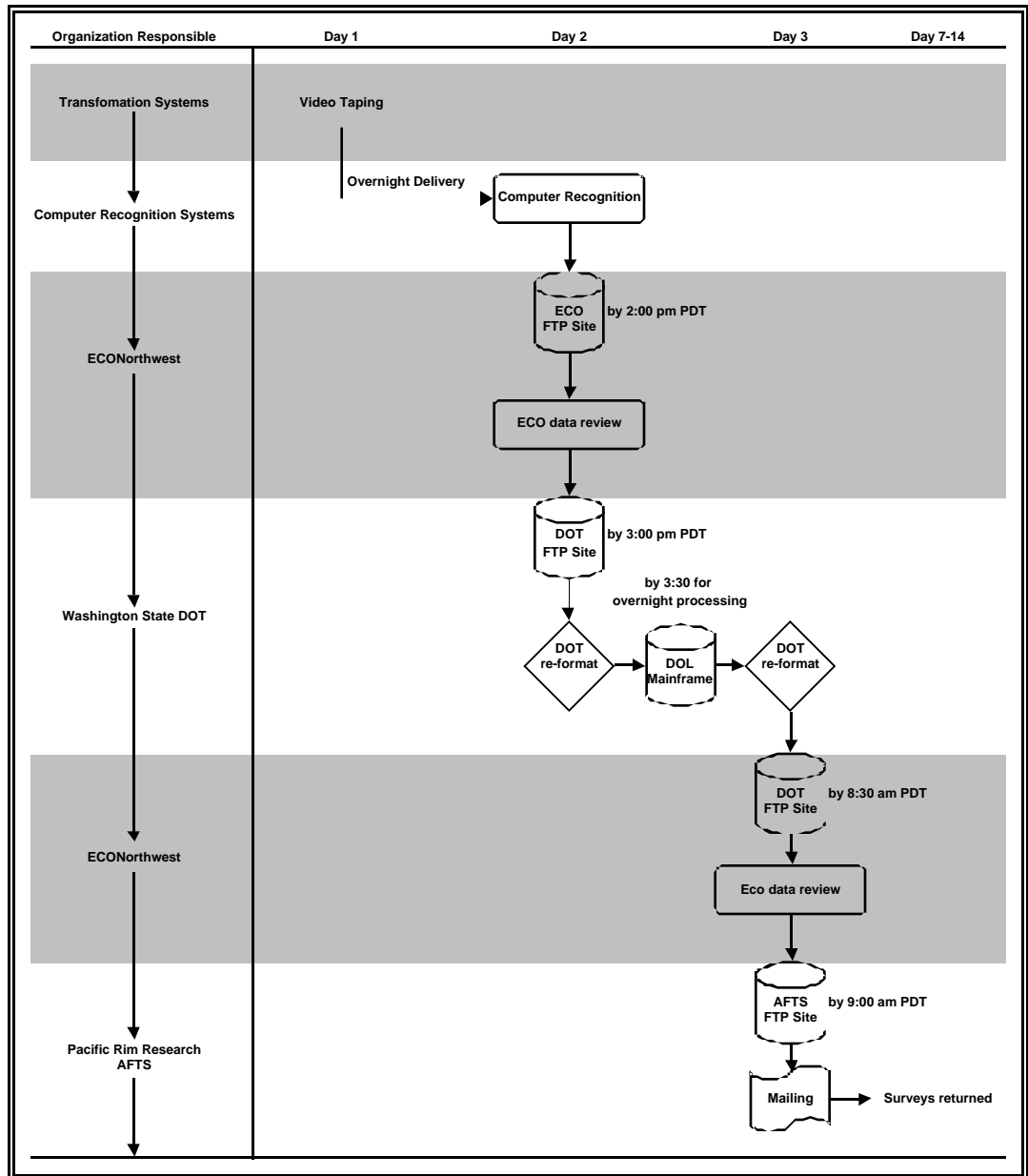
CRS processed the tapes the following day using special optical character recognition technology to produce a data file of license plate numbers. Each entry in the data file shows the license plate number of the vehicle, as well as the time, date, and direction of travel. By 2:00 pm (Pacific), CRS sent the data files to ECONorthwest via an internet File Transfer Protocol (FTP) connection.

ECO created a database of all license plates recorded, eliminated any duplicate records, and sent the files to the Washington State Department of Transportation's FTP site by 3:30 pm. WSDOT downloaded the files and recorded them on magnetic tape to be read by the Department of Licensing's mainframe that night.

During the night, the Department of Licensing ran a query of its database that matched the license plates obtained in the video survey to registered vehicle owners listed in the database. The resulting data file contained vehicle registration addresses and vehicle class information appended to the license plate numbers. Each morning, WSDOT placed the files back on its FTP site where ECONorthwest retrieved them.

ECO then matched the returned addresses with the trip information provided by CRS and created a mail merge file that included the name of the registered vehicle owner; the mailing address; and the date, time and direction that the vehicle was identified on the bridge. ECO placed the file on the FTP site of AFTS, a Seattle mail house, by 9:00 am. AFTS retrieved the files and printed and mailed the surveys on the same day.

The data transfer process is represented in Figure 2.1.

Figure 2.1. Data Transfer Flow Chart

Over 36,000 license plate images were collected in the video survey. After eliminating all duplicate records, this number was reduced to nearly 26,000 unique plates. Of this total, approximately 19,500 were matched to Washington addresses. The 6,500 images that did not match to records in the Department of Licensing's database were from out-of-state vehicles or were improperly read by the automated video survey equipment.

Surveys were mailed to 18,000 registered owners of vehicles that made at least one trip across the bridge during the survey period. The study identified 19,415 potential survey recipients, representing 28 percent of the total traffic for the hours videotaped. If the duplicates had not been

eliminated from the database, the total amount of license plates matched to addresses in the DOL database would have been 28,954 vehicles, or 42 percent of the actual traffic. A summary of this information appears in Table 2.2.

Table 2.2 Video Survey Summary Data

| | |
|--|--------|
| Vehicles using bridge during taping | 69,243 |
| Number of license plates read | 36,172 |
| Percent of plates read to vehicles during taping | 52% |
| Unique license plates | 25,760 |
| Percent of unique to number read | 71% |
| Number of addresses from DOL | 19,415 |
| Percent of DOL match to unique license plates | 75% |

ORIGIN/DESTINATION SURVEY

Pacific Rim Research (PRR) coordinated the survey sent to bridge users regarding their origin and destination locations. ECO and PRR worked with WSDOT staff to design the survey prior to the videotaping. The consultant team designed the survey so that respondents could assure their anonymity by removing the portion of their survey containing their name and address. Given the privacy concerns over the use of a video survey, the team made efforts to assure the survey recipients that the scope of the survey was limited and that their personal information would not be used for any other purpose.

As part of the survey design process, PRR sent sample surveys to a group of 30 test participants. The test participants completed the sample surveys and participated in review discussions with PRR staff members who compiled their suggestions. The survey underwent several modifications based on the recommendations of the test group, WSDOT staff, and members of the consultant team.

The survey consists of the 11 questions listed in Table 2.3 below, which were to be completed by the driver of the vehicle on the trip identified. If a recipient received the survey in error, the respondent was instructed to check a box in Question Number 1 stating that no member of the household was traveling on the bridge during the time indicated and to return the survey. The questions address the origin, destination and purpose of the trip, frequency of bridge use, number of people in the vehicle, and vehicle type. One question pertains to the use of ferries, and another relates to alternate routes that would be used if the bridge were closed. The bottom third of the survey is a map of western Washington, divided into 28 zones. The survey recipients used the map zones to code the origin and destination of the one-way trip identified on the survey questionnaire. A complete

sample of the survey that includes the multiple-choice options and map is included as Appendix A.

Table 2.3 Survey Questions

| # | Survey Question |
|-----|---|
| 1. | If none of the members of your household were traveling on the Hood Canal Bridge (as shown in the trip information on the other side of this survey right above your name) please check this box and return the survey to us uncompleted. |
| 2. | What was the city/town and state where you <i>started</i> the above referenced trip? |
| 3. | Using the map below, please write the zone number in this box where you <i>started</i> the above referenced trip. |
| 4. | The primary purpose of this trip was transportation to/from: |
| 5. | What was the city/town and state where you <i>ended</i> this trip? |
| 6. | Using the map below, please write the zone number in this box where you <i>ended</i> your trip. |
| 7. | How many times per week do you use the Hood Canal Bridge in this direction? |
| 8. | Including yourself, how many people were in your vehicle? |
| 9. | Please identify the type of vehicle you were driving. |
| 10. | Did you take any ferries on this trip? If yes, please identify by circling the appropriate ferry/ferries below. |
| 11. | If you knew before you took this trip that the Hood Canal Bridge was going to be closed, what would you have done? |

The daily file that ECO sent to the mail house included both address information for delivery purposes and trip information for reference by the survey respondent. The surveys were mailed out between June 8 and June 15, 1998. PRR received 7,000 surveys through July 7, of which 6,764 were coded for the origin/destination survey. The high response rate of 39 percent suggests that the surveys reached the appropriate audience in a timely manner, that the survey recipients have a strong interest in the future of the bridge, and that they are willing to contribute to the planning for the bridge closure.

Statistical Validity

The sample size of 7,000 is large for surveys of this type and generates statistically valid results regarding the existing patterns of use and trip purpose. A random sample of 6,764 responses drawn from a population of nearly 70,000 trips during the taping period will yield an accuracy of plus or minus 1.2% or better for those questions posed to the entire population. The error band or “confidence interval” increases somewhat for subgroups such as those traveling in the eastbound direction, or those traveling for leisure

purposes. However, even subgroups that include just 250 survey responses yield results that are accurate to plus or minus 6%.

Another potential concern with any survey research is whether the survey sample reflects a true random sample. A non-random or biased sample could skew the results and undermine measures of statistical validity. In this case, there is no known bias introduced in the reading of the license plates except possibly to undercount dirty vehicles with obscured license plates. It is reasonable to assume, however, that the surveys were mailed to a random sample of the owners of vehicles registered in Washington state that used the facility during the survey period.

There is, however, some concern with non-response bias. Even though 39% is considered a very high response rate for a mailed survey, there is still some risk that the travel patterns of the survey respondents differ from those of non-respondents. The potential for bias is likely in the direction of more responses from frequent users of the facility who have a larger stake in the outcome of the bridge closure. On balance, after reviewing the results, the consultant team determined that any potential non-response bias is likely to be small. The results indicated a very diverse set of trip purposes and close to half of the survey responses were from people who made one or fewer trips per week. The travel patterns confirm what one would expect given the population and employment centers on both sides of the bridge. Policymakers can have a high level of confidence that the survey results present an accurate depiction of the current travel patterns on the bridge.

It is important to remember that the survey data reflect the existing, rather than future uses, of the bridge. The temporary closure of the bridge will substantially alter the relative costs of making a trip across the Hood Canal during that period. These changes in travel costs could significantly change the patterns of trip making during that period. While it is important to understand the existing patterns of bridge usage, any strategies to mitigate the effects of the bridge closure should account for how travelers will respond to those future conditions.

3 KEY FINDINGS

ECO's analysis of Hood Canal Bridge traffic revealed three major factors that should be considered while planning strategies for mitigating the effects of bridge closure. Weekend volume is higher than weekday traffic; over half of all bridge traffic is centered in the communities adjacent to the bridge; and trip purpose determines many bridge use characteristics.

- **Weekend traffic averaged 18,759 vehicles per day, almost 4,000 more vehicles per day than the weekday average of 14,915.** Daily traffic counts provided by WSDOT show that during the survey period, an average of 17,221 vehicles used the Hood Canal Bridge each day. Weekday traffic peaks for eastbound traffic in the morning and for westbound traffic in the evening. Weekend traffic remains consistently high from mid-morning through late evening.
- **Vehicles registered in ten cities near the bridge accounted for 41% of all trips made during the survey period.** The videotape survey of license plates identified over 36,000 license plates during the survey period, of which almost 30,000 were matched to registered owners. According to the origin/destination survey results, the vast majority of traffic over the bridge originates from or ends in the Port Townsend, Port Ludlow, and Sequim/Port Angeles areas on the west side of the bridge and the Poulsbo/Kingston and Bremerton/Port Orchard areas on the east side of the Hood Canal Bridge.
- **Origin/destination survey results show that trip purpose correlates with frequency of travel over the bridge and the ability of travelers to reschedule their trips.** Travelers whose trip purpose was travel to or from work made up 33 percent of weekday traffic. Of the 33 percent, 30 percent use the bridge five or more times per week in the direction identified, and 13 percent say they are unable or unwilling to reschedule their travel if the bridge closes. Leisure travelers comprised 61 percent of all traffic volume over the bridge on weekends. The majority of these travelers (64%) use the bridge once a week or less, and 36 percent are willing to reschedule their travel if the bridge is closed.

WSDOT should consider these three major factors – the day of the week, the proximity of the user to the bridge, and the trip purpose – which affect the volume and flow of the traffic on the bridge when determining mitigation strategies. Each of the three sources of data gathered for this study provides an integral element to the overall analysis of the Hood Canal Bridge traffic. The following daily traffic counts show the volume differences between weekend and weekday traffic and their associated peaks throughout the day. The video survey results show which areas near the bridge will be most affected by a bridge closure. And the origin/destination survey results also show the differences between weekend and weekday volume and provide information on how trip purpose affects the use of the bridge.

DAILY TRAFFIC COUNTS

WSDOT provided ECONorthwest with daily traffic counts for the five-day video survey period. ECO used this information to analyze the actual traffic volume and flows on the bridge. Table 3.1 shows the actual volume for eastbound and westbound traffic on the survey days. The daily traffic summary data show clear differences between weekend and weekday use of the facility. Weekend traffic averaged 18,759 vehicles per day, nearly 4,000 more than the weekday traffic average of 14,915.

Table 3.1 Daily Traffic Summary

| Date | Day | Eastbound | Westbound | Total |
|---------|-----------|-----------|---------------------|---------------|
| June 5 | Friday | 8,456 | 9,978 | 18,434 |
| June 6 | Saturday | 9,093 | 9,992 | 19,085 |
| June 7 | Sunday | 10,572 | 8,187 | 18,759 |
| | | | Weekend Avg. | 18,759 |
| June 9 | Tuesday | 7,383 | 7,354 | 14,737 |
| June 10 | Wednesday | 7,530 | 7,562 | 15,092 |
| | | | Weekday Avg. | 14,915 |

The patterns and flow of this traffic indicate that the mitigation strategies selected will need to account for volume differences between weekend and weekday traffic as well as for variations in the time of day, especially during on weekdays. For the weekend days studied, the traffic volume was consistently high from 9:00 a.m. to 9:00 p.m., with a peak at 6:00 p.m. of 738 vehicles per hour traveling eastbound. The volume was over 500 vehicles per hour in each direction between 10:00 a.m. and 8:00 p.m. on weekend days.

Figure 3.2 shows the average daily traffic for Friday, June 5, through Sunday, June 7. Each of the three weekend days has a different volume pattern; however, as a group they produce a general pattern of consistently high traffic from mid-morning through late evening.

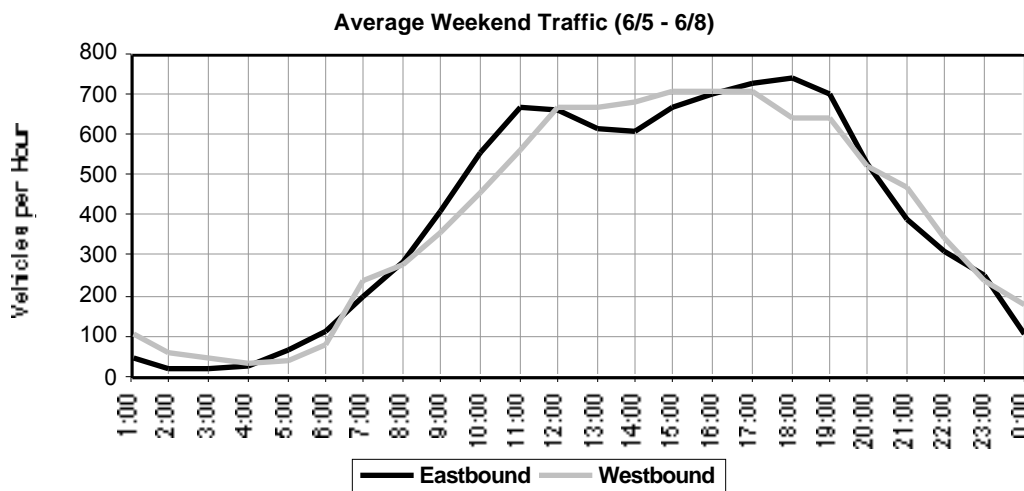
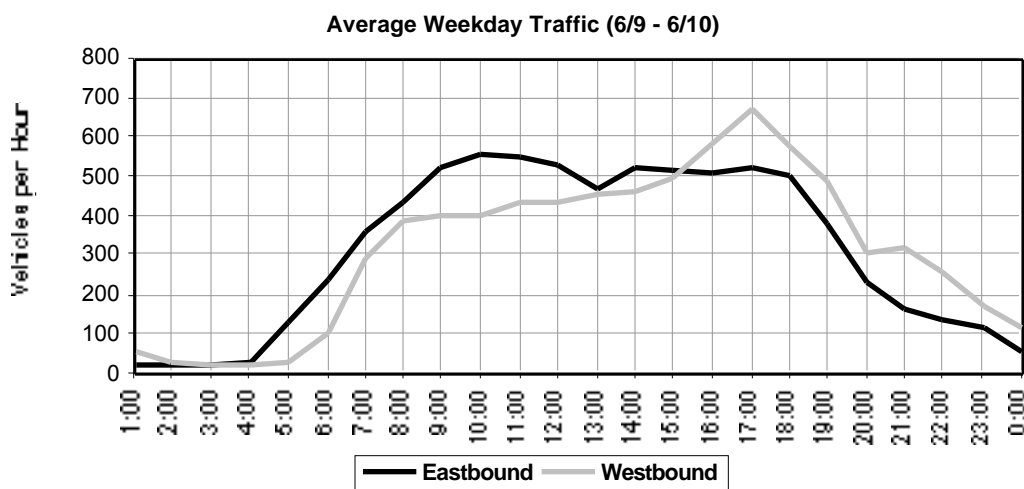
Figure 3.2. Weekend Daily Traffic Summary Graph

Figure 3.3 shows daily traffic for weekdays by direction. Weekday traffic flows peaked in the morning for eastbound traffic and in the evening for westbound traffic, indicating that the bridge is used by commuters traveling to and from work. Although the graph clearly shows that the bridge is a commuter facility, the weekday morning and evening “peaks” did not exceed the weekend volume.

Figure 3.3. Weekday Daily Traffic Summary Graph

VIDEO SURVEY

The video license plate survey provided the source for the registration data used to mail the origin/destination surveys to bridge users. The raw data obtained during the survey itself provides valuable insights as well. ECO used the vehicle registration data to determine the cities and towns that will be most affected by a bridge closure. Although use of the facility by residents

of larger cities such as Seattle and Tacoma is high, their per capita use is relatively low.

Table 3.2 contains a list of all cities with more than 250 trips, ranked according to the number of trips per capita over the bridge. This table shows that vehicles registered in the immediate area generate the vast majority of traffic on the bridge and that the use of the facility by local drivers is significantly higher than for travelers from other areas of the state. Of the 482 place names recorded, vehicles registered in the top ten communities listed below made 41 percent of all trips during the survey period. These figures confirm what one would expect: people who live in the immediate area will be the most affected by the bridge closure.

Table 3.2 Traffic Volume by Place

| Rank | City, Town, or Community | Count | Population | Per capita count | Cumulative % of total |
|--------------|--------------------------|---------------|------------|------------------|-----------------------|
| 1 | Port Ludlow | 2,848 | 1,500 | 1.899 | 8% |
| 2 | Sequim | 1,839 | 4,375 | 0.420 | 13% |
| 3 | Port Hadlock | 886 | 2,742 | 0.323 | 15% |
| 4 | Port Townsend | 2,494 | 8,330 | 0.299 | 22% |
| 5 | Poulsbo | 1,740 | 6,175 | 0.282 | 27% |
| 6 | Quilcene | 695 | 3,000 | 0.232 | 29% |
| 7 | Port Angeles | 2,202 | 18,890 | 0.117 | 35% |
| 8 | Kingston | 621 | 5,507 | 0.113 | 37% |
| 9 | Port Orchard | 687 | 6,965 | 0.099 | 39% |
| 10 | Silverdale | 720 | 7,660 | 0.094 | 41% |
| 11 | Gig Harbor | 259 | 4,130 | 0.063 | 41% |
| 12 | Bremerton | 1,567 | 38,600 | 0.041 | 46% |
| 13 | Bainbridge Island | 620 | 18,920 | 0.033 | 47% |
| 14 | Renton | 276 | 45,920 | 0.006 | 48% |
| 15 | Seattle | 2,151 | 536,600 | 0.004 | 54% |
| 16 | Kent | 279 | 62,006 | 0.004 | 55% |
| 17 | Tacoma | 646 | 185,600 | 0.003 | 57% |
| 18 | Bellevue | 353 | 104,800 | 0.003 | 58% |
| 19 | Spokane | 288 | 188,300 | 0.002 | 59% |
| 20 | Chimacum | 551 | | | 60% |
| | <i>442 Other Places</i> | <i>14,450</i> | | | <i>40%</i> |
| Total | 462 Places Total | 36,172 | | | 100% |

ORIGIN/DESTINATION SURVEY

By July 7, 1998, Pacific Rim had received 7,000 completed survey responses from the 18,000 surveys mailed, representing a 39 percent response rate. Of the 7,000 completed surveys, 236 respondents checked the box in Question Number 1 indicating that they were not on the bridge during the survey period. The consultant team used the remaining 6,764 responses as the basis for the origin/destination trip tables, maps, graphs, and analysis of facility usage. With a sample of 6,764 from a population of 69, 243, the survey results have an error range of less than 1.2%.

Weighting Results and Adjusting Data

During the data transfer and review process, ECO eliminated duplicate license plates recorded and sent only one survey to each person using the bridge during the survey period. Therefore, to achieve a representative sample of the actual traffic flows over the bridge, ECO adjusted the survey responses to give a higher weight to the trips taken by travelers who reported using the bridge more than once per week.

Without weighting the survey responses, the results would underrepresent the responses of the frequent bridge users. For example, a driver using the bridge three times on the weekend would receive only one survey, the same as someone making a single trip over the bridge. Weighting the responses allows a presentation of findings that accurately represents the actual traffic flows on the bridge.

The weighting factor is based on the percentage of unique license plates recorded during the original video survey, which was 80 percent for the weekend survey period and 58 percent for the weekday taping. ECO adjusted the survey results based on these percentages by multiplying each survey in which the respondent reported using the bridge more than once a week by an adjustment factor to expand the number of survey responses and account for the vehicles eliminated as duplicates.

Table 3.3 Weighting Factor Calculations

| | | Weekend | Weekday |
|----------|--|----------------|----------------|
| a | Percent of unique license plates in survey | 0.80 | 0.58 |
| b | Percent of duplicate license plates eliminated | 0.20 | 0.42 |
| c | Surveys reporting multiple trips per week | 1,573 | 956 |
| d | Total surveys returned | 4,561 | 2,156 |
| e | Adjusted survey total (d/a) | 5,701 | 3,717 |
| f | Percent of multiple trips per week (c/e) | 0.2759 | 0.2572 |
| g | Weighting factor (b/f) | 0.725 | 1.633 |

Before creating the trip tables that follow, ECO analyzed the survey results and made logical adjustments to the data. In several cases, respondents identified the same zone as both the origin and destination of their one-way trip or the origin and destination were both on the same side of the bridge. For example, a traveler may have indicated that he or she began the trip east of the bridge in Poulsbo and ended in Bremerton, also east of the bridge. Logic tests were performed on these cases, and the responses were either adjusted or eliminated as described below.

To conduct the logic tests, ECO grouped the zones on the survey map into three categories – East, West, and Neutral – based on their location in relation to the bridge. Zones in the West group include zones 1, 2, 6, 7, 26, and 27, which represent Port Ludlow, Port Townsend, and sites in Jefferson and Clallam counties. Zones in the East group include zones 3, 5, and 8 through 21. Zones 3 and 5 represent the Kingston/Poulsbo and Bremerton/Port Orchard areas; zone 4 is Island County; and zones 8 through 21 include all other points in Western Washington between Puget Sound and the Cascades, Eastern Washington, and any points in Canada. Zones 22 through 25 and 28, covering Grays Harbor, Mason, and Thurston Counties, and states to the south, are considered “Neutral,” meaning that in theory a site in this group could be either an origin or destination for eastbound or westbound traffic.

Cases also occurred in which the origin and destination were on opposite sides of the bridge, but the direction of travel was not logically consistent. Since the direction was known to be correct from the video survey, the consultant team made the assumption that these individuals misread the question and switched the origin and destination in their survey response. For this group, ECO switched the origin and destination reported to make the direction logically correct.

The trip tables that follow were generated based on a total of 6,608 weighted and adjusted trips. ECO applied the weight factor and conducted the logical origin, destination, and direction checks on the 6,764 completed surveys to arrive at this adjusted total.

Origin/Destination Maps and Trip Tables

The origin/destination maps and trip tables appear on the following pages. Each trip table and map are presented on facing pages to display traffic flows both graphically and in tabular form. The tables include only the origins and destinations that are logically possible for the given direction.

These maps and charts show the appropriate origins and destinations of all trips for a given day and direction. The percentages are based on the total number of weighted and adjusted trips as derived using the methods described above. The total adjusted number of trips is listed in each chart. Blank cells in the charts indicate that no trips were made with that particular origin/destination combination, while cells showing 0 percent represent cases

in which trips with that origin/destination combination existed but the percentage was less than 0.5 percent.

In general, the maps and tables reflect the following patterns:

Weekends: Central and northern Kitsap County account for 48% of all origins in the westbound direction. The Seattle area contributes another 16% of trip origins. The zones including Port Ludlow, Port Townsend, Sequim, and Port Angeles account for 87% of the westbound destinations on the weekends. The eastbound trips on the weekends are a mirror image of the westbound trips with 88% originating in the areas around Port Ludlow, Port Townsend, Sequim, and Port Angeles, and 68% destined to central and northern Kitsap County and Seattle.

Weekdays: The weekday travel patterns show a higher percentage of trip origins and destinations in central and northern Kitsap County, with 55% of the westbound origins compared to 48% on weekends. Port Ludlow, Port Townsend, Sequim, and Port Angeles account for 90% of the destinations compared to 87% on weekends. As with the weekend traffic, the eastbound trips are a mirror image of the westbound trips.

Commuting Peak on Weekdays: Port Ludlow, Port Townsend, Sequim, and Port Angeles account for 92% of the origins of trips in the morning eastbound peak. Central and northern Kitsap Peninsula account for 60% of destinations. Seattle accounts for 18% of destinations with another 14% destined to other urban areas in King and Snohomish counties. There appear to be significant numbers of commuters who live west of the Hood Canal bridge and commute to the east side of Puget Sound in the morning. The afternoon return commute shows a similar pattern, with 17% of the trips originating in Seattle and 11% in other parts of King and Snohomish Counties.

ORIGIN/DESTINATION MAPS AND TRIP TABLES

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Table 3.4 Weekend Westbound – Origin/Destination Map

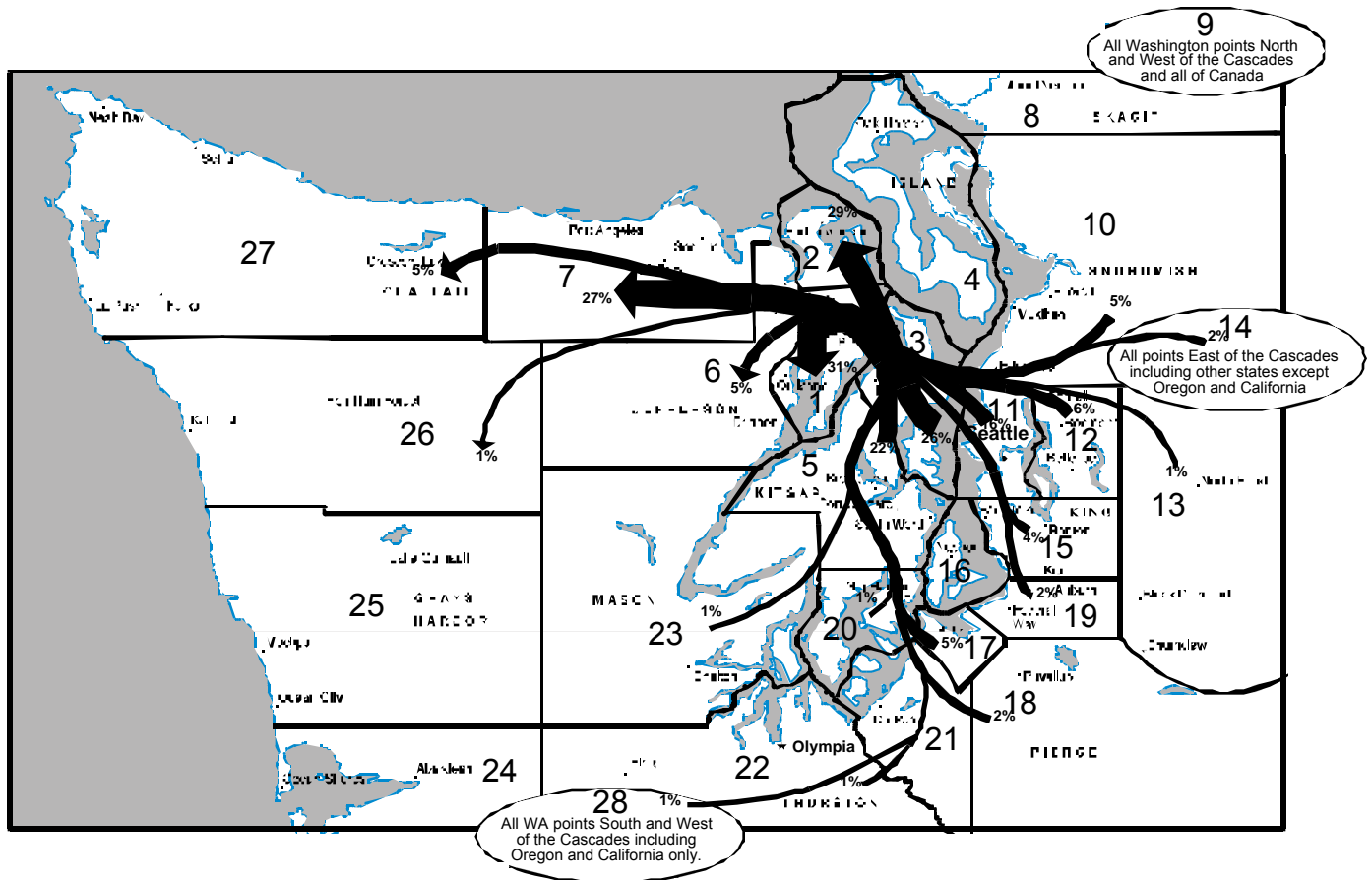


Table 3.5 Weekend Westbound – Origin/Destination Table**Total Trips = 2,024****Destination****Origin**

| | | 1 | 2 | 6 | 7 | 22 | 23 | 24 | 25 | 27 | 27 | 28 | |
|-------------------------|----|-------------|---------------|-----------|------------|--------------|--------------|-----------|-----------|------------|---------------|-------------|-------------|
| | | Port Ludlow | Port Townsend | Bremerton | Sequim | Port Angeles | Mason County | Skagit | Grays Har | Is. Japons | Is. C. Japons | SW WA/OR/CA | Total |
| Kingston/Poulsbo | 3 | 12% | 7% | 1% | 5% | 0% | 0% | | 0% | 0% | | 0% | 26% |
| Island County | 4 | 0% | 0% | | 0% | | | | | | | | 0% |
| Bremerton/Port Orchard | 5 | 8% | 7% | 1% | 6% | | | | 0% | 0% | | 0% | 22% |
| Skagit Conty | 8 | 0% | | | | 0% | | | | 0% | | | 0% |
| NE WA/Canada | 9 | 0% | 0% | | 0% | | | | | | | | 0% |
| Snohomish County | 10 | 1% | 2% | 1% | 2% | | | 0% | | 1% | | 0% | 5% |
| Seattle | 11 | 4% | 5% | 1% | 4% | 0% | | 0% | 0% | 1% | | 0% | 16% |
| Bellevue | 12 | 2% | 2% | 0% | 2% | 0% | | | 0% | 0% | | | 6% |
| King County | 13 | 1% | 0% | 0% | 0% | | | | | 0% | | | 1% |
| E WA/States to the East | 14 | 0% | 1% | | 1% | | | | | 0% | | | 2% |
| South King County | 15 | 1% | 1% | 0% | 2% | | | | | 0% | | | 4% |
| Vashon Island | 16 | | 0% | | 0% | | | | | 0% | | | 0% |
| Tacoma | 17 | 1% | 1% | 0% | 2% | | 0% | | | 1% | | | 5% |
| SE Pierce County | 18 | 0% | 0% | | 1% | | | | | 0% | | | 2% |
| Federal Way/Auburn | 19 | 0% | 0% | | 1% | 0% | | | | 0% | | | 2% |
| Gig Harbor | 20 | 0% | 0% | 0% | 1% | | | | | 0% | | | 1% |
| W Pierce County | 21 | 0% | | | 0% | | | | | | | | 0% |
| Thurston County | 22 | | 0% | | 0% | | | | | 0% | | | 1% |
| Mason County | 23 | 0% | 0% | | 0% | | | | | | | | 1% |
| Aberdeen | 24 | | | | | | | | | | | | |
| Grays Harbor County | 25 | | 0% | | | | | | | | | | 0% |
| SW WA/OR/CA | 28 | 0% | 0% | | 0% | | | | | 0% | | | 1% |
| | | 0% | 0% | 0% | 0% | | | | | | | 1% | 2% |
| Total | | 31% | 29% | 5% | 27% | 0% | 0% | 0% | 1% | 5% | | 1% | 100% |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

Kingston/Poulsbo and Bremerton/Port Orchard account for 48 percent of all origins; Seattle had 16 percent. Destinations are Port Ludlow, Port Townsend, and Sequim/Port Angeles with a total of 87 percent among them.

Figure 3.4. Weekend Eastbound – Origin/Destination Map

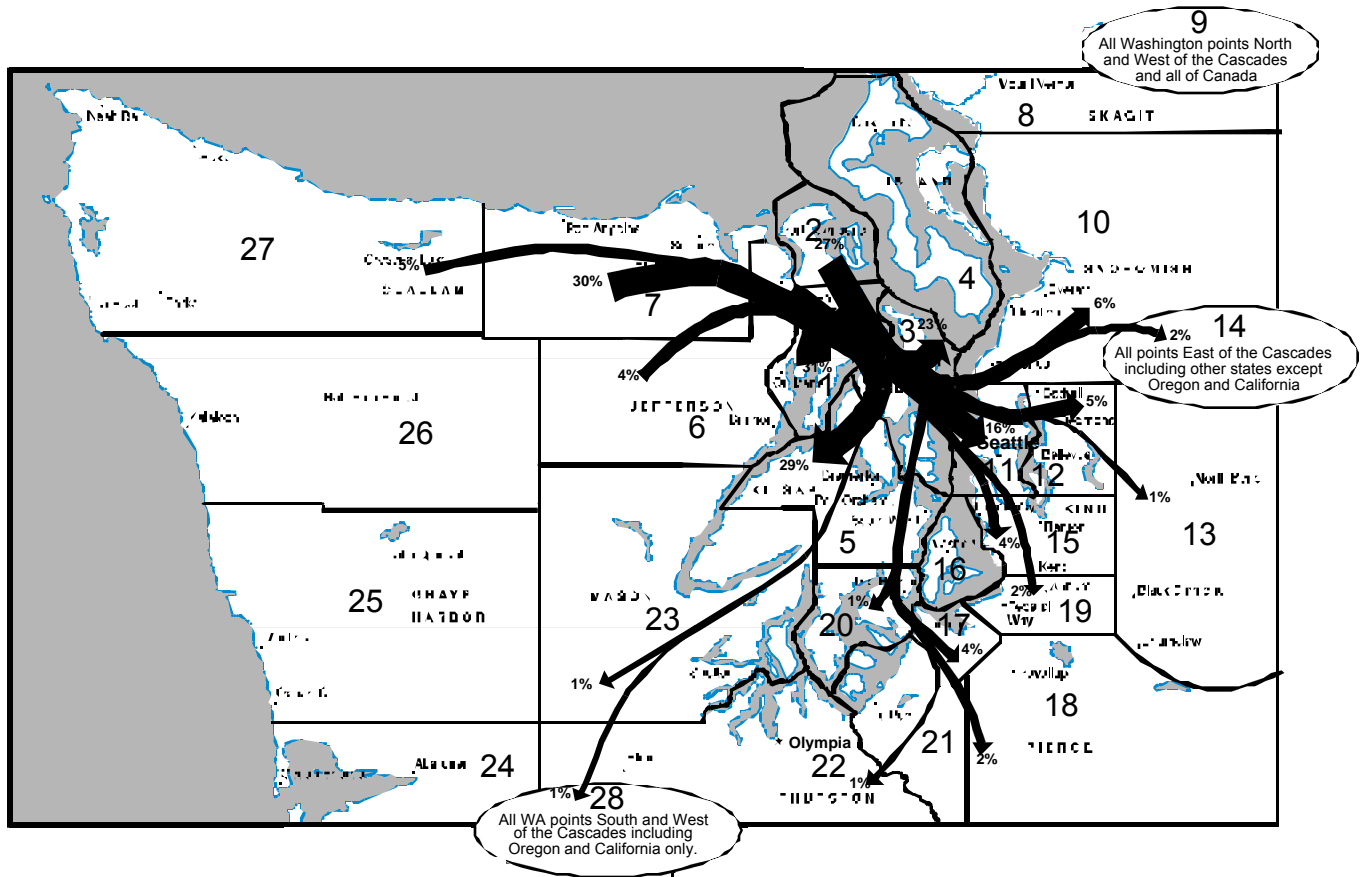


Table 3.6 Weekend Eastbound – Origin/Destination Table

Total Trips = 1,902

| Total Trips = 1,902 | | Destination | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----|---|----|-----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| | | King Is. / W. Long Is. / Pt. Adams / Bremerton / Sequim / Port Angeles / San Juan / County / Seattle / Ballard / E. King Co. / Elsie / St. King Co. / Marine Island / Tacoma / SE. King Co. / Federal / Olympia / Kitsap / Thurston / Mason County / Grays Harbor / Port Hadley / SW WA/OR/CA | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Origin | | 3 | 4 | 5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 28 | | | | | | |
| Port Ludlow | 1 | 13% | 0% | 10% | 0% | 0% | 1% | 3% | 1% | 0% | 0% | 1% | | 0% | 0% | 0% | 0% | 0% | 0% | | | | | 0% | | | | | |
| Port Townsend | 2 | 5% | 0% | 9% | | | 2% | 4% | 1% | 0% | 1% | 1% | | 1% | 0% | 0% | 0% | | 0% | 0% | | | | 0% | 0% | | | | |
| E. Jefferson County | 6 | 1% | | 2% | | | 0% | 1% | 0% | 0% | 0% | | | 0% | 0% | 0% | 0% | | 0% | 0% | | | | 0% | 0% | | | | |
| Sequim/Port Angeles | 7 | 4% | 0% | 7% | 0% | 0% | 2% | 6% | 2% | 0% | 1% | 1% | 0% | 2% | 1% | 0% | 1% | 0% | 0% | 0% | | | | 0% | 0% | | | | |
| Thurston County | 22 | | | | | 0% | | | | | | | | | | | | | | | | | | | | | | | |
| Mason County | 23 | 0% | | 0% | | | 0% | | 0% | | | | | | | | | | | | | | | | | | | | |
| Aberdeen | 24 | | | | | | | | | | | | | | | | | | 0% | | | | | | | 0% | | | |
| Grays Harbor County | 25 | | | | | | | 0% | 0% | | | | | 0% | | | | | | | | | | | | | | | |
| W. Jefferson County | 26 | 0% | | 0% | | | 0% | | | | | 0% | | | | 0% | | | | | | | | | | | | | |
| W. Clallam County | 27 | 0% | | 1% | 0% | | 0% | 1% | 0% | 0% | 0% | 0% | | 0% | 0% | 0% | 0% | 0% | 0% | | | | | | | | | | |
| SW WA/OR/CA | 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0% | | 0% | | 0% | | | | | | | | 0% | | | | | | | | | | | 0% | 1% | | | |
| Total | | 23% | 0% | 29% | 0% | 0% | 6% | 16% | 5% | 1% | 2% | 4% | 0% | 4% | 2% | 2% | 1% | 0% | 1% | 1% | | | | | 1% | 1% | 1% | 1% | |
| Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

Eighty eight percent of all trips originated in Port Ludlow, Port Townsend, and Sequim/Port Angeles. Kingston/Poulsbo, Bremerton/Port Orchard, and Seattle accounted for 68 percent of destinations.

Figure 3.5. Weekday Westbound – Origin/Destination Map

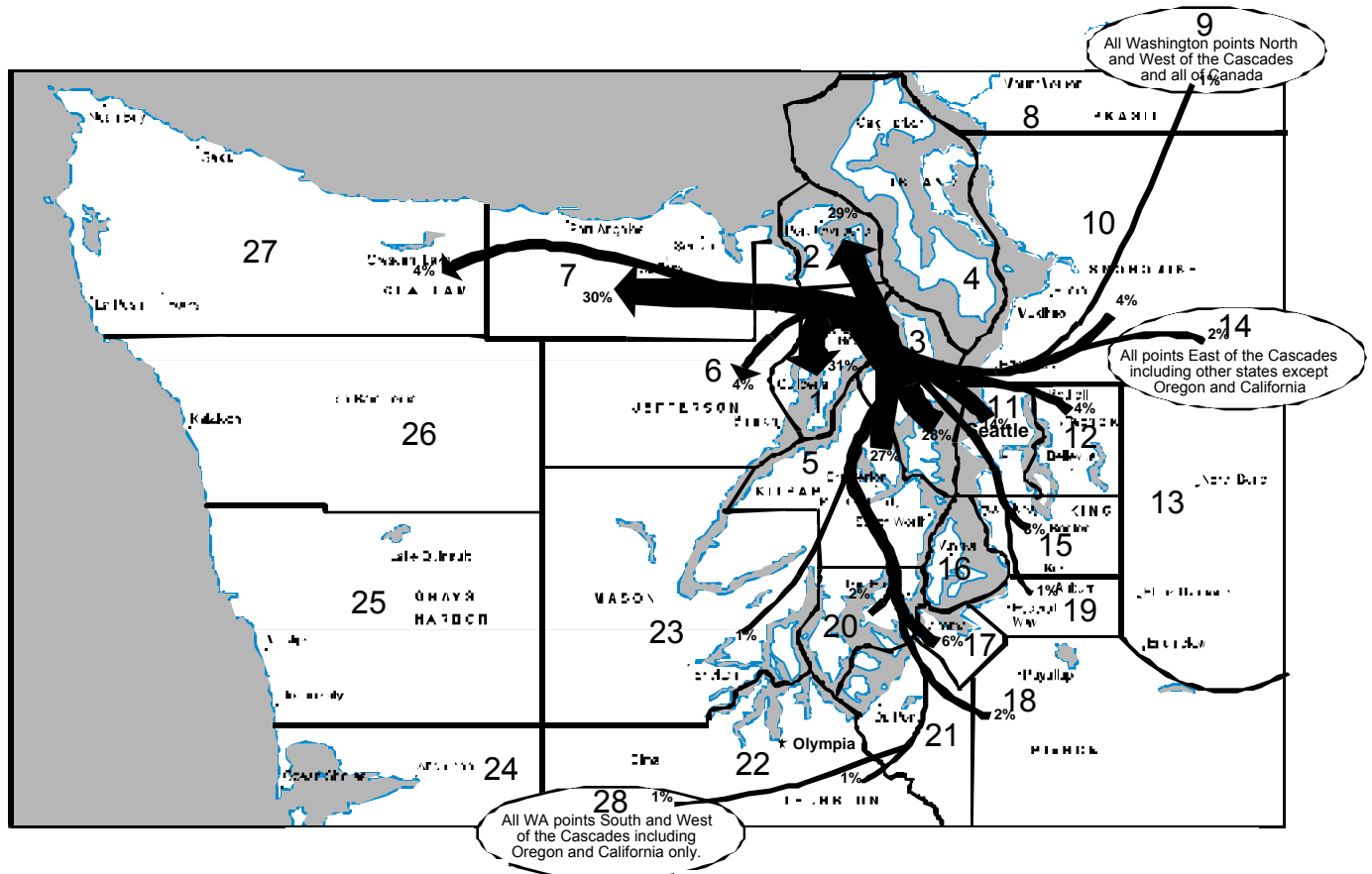


Table 3.7 Weekday Westbound – Origin/Destination Table

Total Trips = 1,534

DestinationOrigin

| | | Port Ludlow | Port Townsend | Bremerton | Sequim/Port Angeles | Thurston Co. | Island County | Snohomish Co. | Grays Harbor | W. Jefferson | W. Clark | SW WA/OR/CA | Total |
|-------------------------|----|-------------|---------------|-----------|---------------------|--------------|---------------|---------------|--------------|--------------|-----------|-------------|-------------|
| | | 1 | 2 | 6 | 7 | 22 | 23 | 24 | 25 | 27 | 27 | 28 | |
| Kingston/Poulsbo | 3 | 13% | 10% | 1% | 4% | | | | | | 0% | 0% | 28% |
| Island County | 4 | | | | 0% | | | | | 0% | | | 0% |
| Bremerton/Port Orchard | 5 | 10% | 9% | 1% | 7% | | | | | 0% | 1% | | 27% |
| Skagit County | 8 | | | | 0% | | | | | | | | 0% |
| NE WA/Canada | 9 | 0% | 0% | | 0% | | | | | | | | 1% |
| Snohomish County | 10 | 1% | 1% | 0% | 2% | | | | | 0% | 0% | | 4% |
| Seattle | 11 | 3% | 4% | 1% | 5% | | | | | 0% | 1% | 0% | 14% |
| Bellevue | 12 | 1% | 1% | 0% | 2% | | 0% | | 0% | | 0% | | 4% |
| King County | 13 | 0% | | | 0% | | 0% | | | | | | 0% |
| E WA/States to the East | 14 | 0% | 0% | | 1% | | | | | | 0% | 0% | 2% |
| South King County | 15 | 1% | 1% | 0% | 2% | | | | | 0% | 0% | | 3% |
| Vashon Island | 16 | | 0% | | | | | | | | | | 0% |
| Tacoma | 17 | 1% | 1% | | 3% | | | | | | 0% | | 6% |
| SE Pierce County | 18 | 0% | 0% | 0% | 1% | | | | | | 0% | | 2% |
| Federal Way/Auburn | 19 | 0% | 0% | | 0% | | | | | | 0% | | 1% |
| Gig Harbor | 20 | 0% | 1% | 0% | 1% | | | | | | 0% | | 2% |
| W Pierce County | 21 | | 0% | | | | | | | | | | 0% |
| Thurston County | 22 | 0% | 0% | | 0% | | | | | | | | 1% |
| Mason County | 23 | 0% | 0% | 0% | 0% | | | | | | | | 1% |
| Aberdeen | 24 | | | | | | | | | | | | |
| Grays Harbor County | 25 | | | | | | | | | | | | |
| SW WA/OR/CA | 28 | | 0% | | 1% | | | | | | | | 1% |
| | | | 0% | 0% | 0% | | | | | | 0% | 1% | 1% |
| Total | | 31% | 29% | 4% | 30% | | 0% | | 0% | 0% | 4% | 1% | 100% |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

Kingston/Poulsbo and Bremerton/Port Orchard origins increased to 55 percent of the total compared to 48 percent on weekends; all other origins decreased. Port Ludlow, Port Townsend, and Sequim/Port Angeles were the major destinations, representing 90 percent. This is similar to the weekend total of 87 percent

Figure 3.6. Weekday Eastbound – Origin/Destination Map

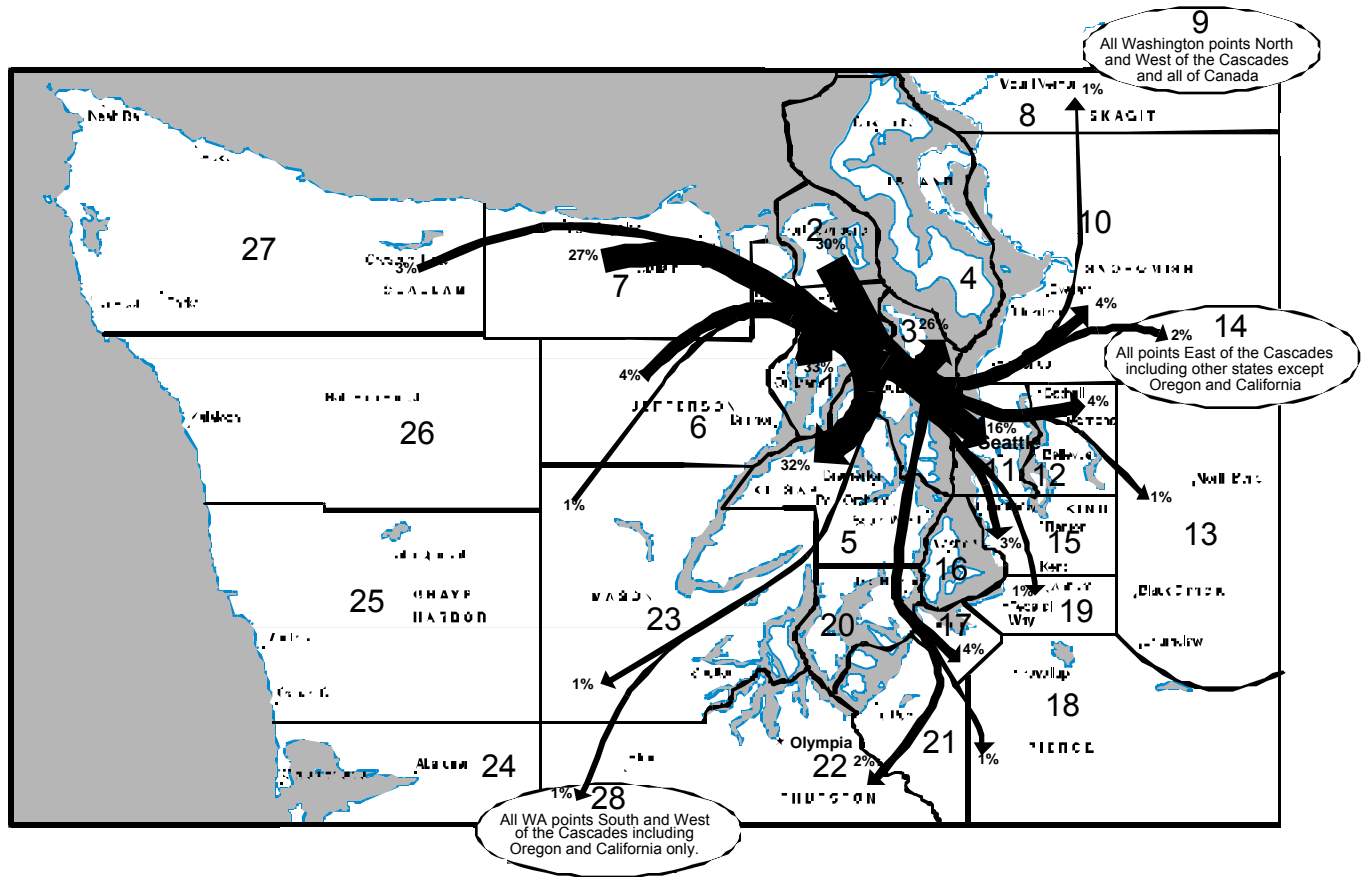


Table 3.8 Weekday Eastbound – Origin/Destination Table

Total Trips = 1,149

| Origin | Destination | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|-------------|----|-----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|----|----|------|-----|
| | 3 | 4 | 5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 28 | | | | | | |
| Port Ludlow | 13% | | 12% | 0% | | 0% | 4% | 1% | 0% | | 1% | | 1% | 0% | 0% | 0% | | 0% | 0% | | | | 0% | | | | 0% | 33% |
| Port Townsend | 9% | | 10% | | | 2% | 5% | 1% | | 1% | 1% | | 1% | | | | | 0% | 0% | | | | 0% | | | | 0% | 30% |
| E Jefferson County | 1% | | 2% | | | 0% | 1% | | | | | | | 0% | 0% | 0% | | | | | | | 0% | | | | 0% | 4% |
| Sequim/Port Angeles | 3% | 0% | 8% | 0% | 0% | 2% | 5% | 2% | 0% | 1% | 1% | | 1% | 1% | 1% | 0% | 0% | 1% | 0% | | 1% | 0% | | | 1% | 0% | 27% | |
| Thurston County | | 0% | | | | 0% | | | | | | | | | | | | | | | | | | | | | | 0% |
| Mason County | | | | | | | 0% | | | | | | | | | | | | | | | | | | | | | 0% |
| Aberdeen | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grays Harbor County | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W Jefferson County | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W Clallam County | 0% | | 0% | | | 0% | 1% | 0% | | 0% | 0% | | 1% | | | | | | | | | | | | | | 0% | 3% |
| SW WA/OR/CA | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0% | 0% | | | | | | | | | | | | | | | | | | | | | | | | | 0% |
| Total | 26% | 0% | 32% | 1% | 0% | 4% | 16% | 4% | 1% | 2% | 3% | | 4% | 1% | 1% | 0% | 0% | 2% | 1% | | | 1% | 1% | | 1% | 1% | 100% | |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

Origin in Port Ludlow, Port Townsend, and Sequim/Port Angeles equaled 90 percent, which matches the 90 percent destination rate for these zones observed for Weekday Westbound traffic. Destination zones in this case were primarily Kingston/Poulsbo, Bremerton/Port Orchard, and Seattle, with the first two accounting for 58 percent of all destinations.

Figure 3.7. AM Eastbound Peak – Origin/Destination Map

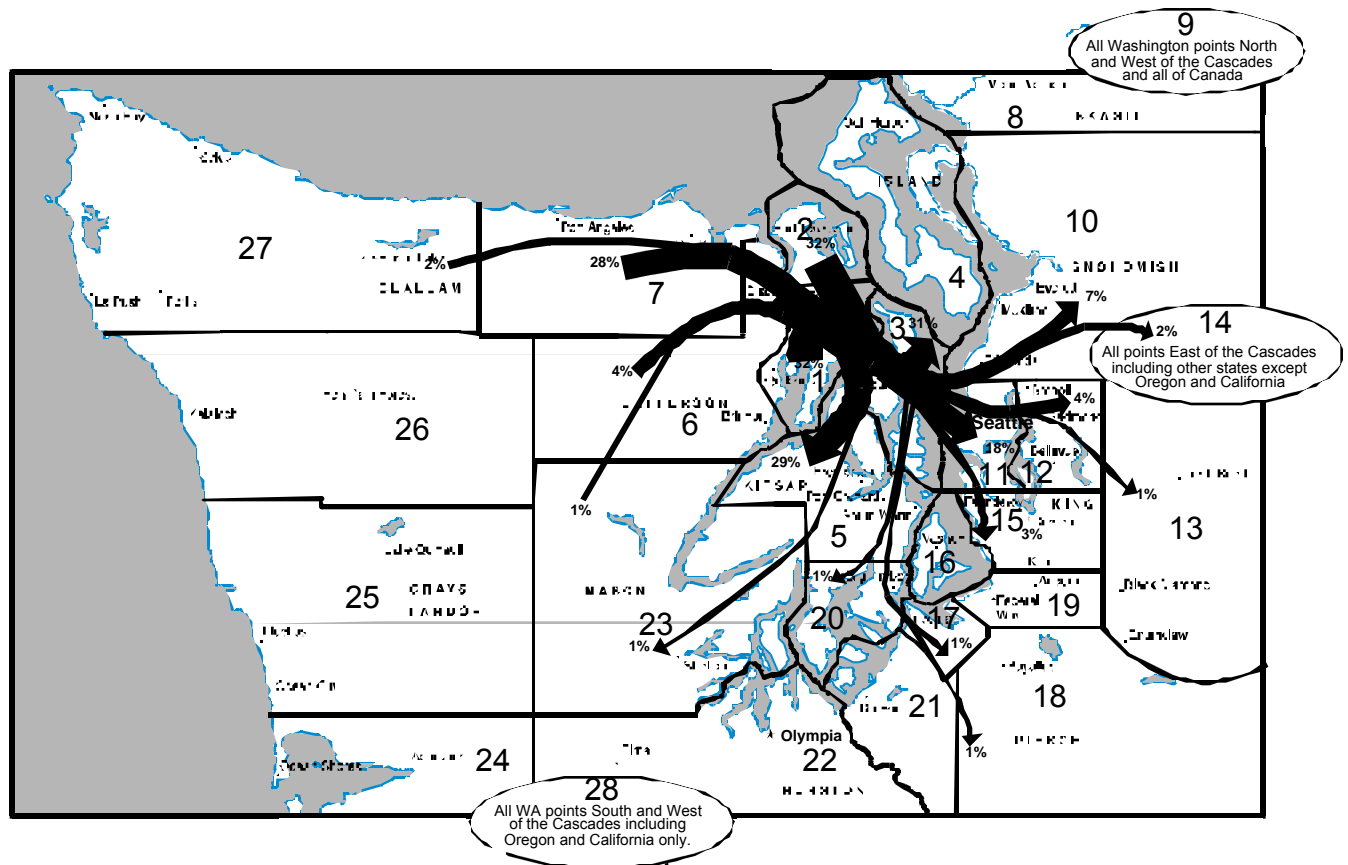


Table 3.9 AM Eastbound Peak – Origin/Destination Table

Total Trips = 385

| Total Trips = 385 | | Destination | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|----|--|----|-----|---|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|----|------|----|-------|
| | | <div><div>Kingman</div><div>WashCo</div><div>Triunty</div><div>SequimCo</div><div>HEBAC</div><div>SammRCounty</div><div>Seattle</div><div>Bainbrt</div><div>EKingCo</div><div>ElleACo</div><div>SKingCo</div><div>MarinaIsland</div><div>Takoma</div><div>SEBlum</div><div>PacificNW</div><div>OlyHarbr</div><div>WBlum</div><div>Thurston</div><div>BentonCounty</div><div>Skamania</div><div>OlyHarbr</div><div>SWWA/CA/BCA</div><div>WY</div></div> | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Origin | | 3 | 4 | 5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 28 | | | | | | Total |
| Port Ludlow | 1 | 15% | | 8% | | | 1% | 3% | 1% | 1% | | 2% | | | 0% | | 1% | | | 1% | | | | | | | | 32 | |
| Port Townsend | 2 | 11% | | 8% | | | 5% | 6% | 1% | | 0% | 1% | | | | | | | | | | | 1% | | | | | 32 | |
| E Jefferson County | 6 | 1% | | 3% | | | | | | | | | | | 1% | | | | | | | | | | | | | 4 | |
| Sequim/Port Angeles | 7 | 3% | | 8% | | 0% | 1% | 8% | 3% | | 1% | 1% | | | | 1% | 0% | | 0% | | | | | | | | | 28 | |
| Thurston County | 22 | | | | | | 0% | | | | | | | | | | | | | | | | | | | | | 0 | |
| Mason County | 23 | | | | | | | 1% | | | | | | | | | | | | | | | | | | | | 1 | |
| Aberdeen | 24 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| Grays Harbor County | 25 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| W Jefferson County | 26 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| W Clallam County | 27 | 1% | | 1% | | | | | 0% | | 0% | | | | 0% | | | | | | | | | | | | | 2 | |
| SW WA/OR/CA | 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| | | | 0% | 1% | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| Total | | 31% | 0% | 29% | | 0% | 7% | 18% | 4% | 1% | 2% | 3% | | 1% | 1% | 0% | 1% | 0% | | 1% | | | 1% | | | 1% | 100% | | |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

For this chart, ECO analyzed a subset of the Weekday Eastbound traffic that used the facility between 6:00 and 10:00 a.m. Similar to all Weekday Eastbound traffic, Port Ludlow, Port Townsend, and Sequim/Port Angeles were the origins for the vast majority of the traffic on the bridge. The three zones together made up 92 percent of the volume. Seventy-eight percent of the trips were destined for zones 3, 5, and 11.

Figure 3.8. PM Westbound Peak – Origin/Destination Map

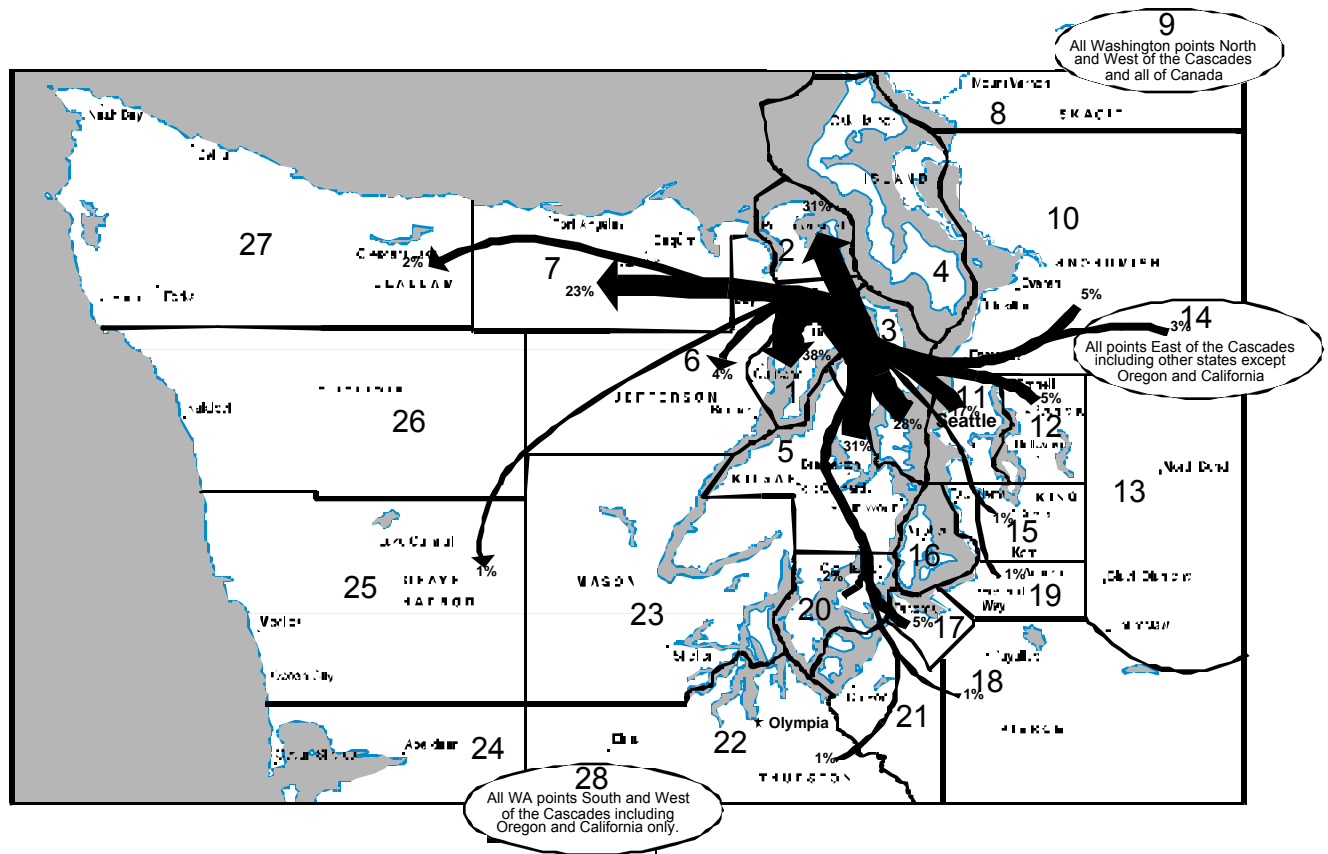


Table 3.10 PM Westbound Peak – Origin/Destination Table

Total Trips = 385

DestinationOrigin

Kingston/Poulsbo
Island County
Bremerton/Port Orchard
Skagit Conty
NE WA/Canada
Snohomish County
Seattle
Bellevue
King County
E WA/States to the East
South King County
Vashon Island
Tacoma
SE Pierce County
Federal Way/Auburn
Gig Harbor
W Pierce County
Thurston County
Mason County
Aberdeen
Grays Harbor County
SW WA/OR/CA

Total

| | 1 | 2 | 6 | 7 | 22 | 23 | 24 | 25 | 27 | 27 | 28 | |
|--------------|------------|------------|-----------|------------|----|----|----|-----------|-----------|-----------|-----------|-------------|
| 3 | 16% | 6% | 1% | 4% | | | | | | | 1% | 28% |
| 4 | | | | | | | | | | 0% | | 0% |
| 5 | 13% | 12% | 0% | 5% | | | | | | 1% | | 31% |
| 8 | | | | | | | | | | | | |
| 9 | | 0% | | 0% | | | | | | | | 0% |
| 10 | 1% | 3% | 1% | 1% | | | | | | | | 5% |
| 11 | 5% | 5% | 1% | 6% | | | | | 0% | 0% | 0% | 17% |
| 12 | 1% | 2% | 0% | 1% | | | | 1% | | | | 5% |
| 13 | 0% | | | | | | | | | | | 0% |
| 14 | 1% | | | 2% | | | | | | | 0% | 3% |
| 15 | | 0% | | 0% | | | | | | | | 1% |
| 16 | | | | | | | | | | | | |
| 17 | 1% | 1% | | 2% | | | | | | 0% | | 5% |
| 18 | | 1% | | | | | | | | | | 1% |
| 19 | | | | | | | | | | | | |
| 20 | | 1% | | 1% | | | | | | 0% | | 2% |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | 0% | | | | | | | | 0% |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 28 | | | | 0% | | | | | | | | 0% |
| | | | | 0% | | | | | | 0% | 1% | 1% |
| Total | 38% | 31% | 4% | 23% | | | | 1% | 0% | 2% | 2% | 100% |

Blank cells = no trips between o/d, 0% = trips taken between o/d were < .5%

Trips in this table were those recorded using the bridge between 4:00 and 8:00 p.m. in a westbound direction. As with the morning peak, the evening peak does not differ markedly from the larger sample. Trip origins were concentrated in zones 3, 5, and 11, comprising 76 percent of all origins. Port Ludlow, Port Townsend, and Sequim/Port Angeles were the destinations for 92 percent of the trips during this period.

Table 3.11 All Traffic Westbound

Total Trips = 3,558

DestinationOrigin

| Origin | | Port Ludlow | Port Townsend | EE/Waterfront County | Sequim/Port Angeles | Thurston County | Mason County | Aberdeen | Grays Harbor County | SW Pierce County | SW WA/OR/CA | Total | |
|-------------------------|----|-------------|---------------|----------------------|---------------------|-----------------|--------------|----------|---------------------|------------------|-------------|-------|------|
| | | 1 | 2 | 6 | 7 | 22 | 23 | 24 | 25 | 27 | 27 | 28 | |
| Kingston/Poulsbo | 3 | 13% | 8% | 1% | 4% | | 0% | 0% | | 0% | 0% | 0% | 27% |
| Island County | 4 | 0% | 0% | | 0% | | | | | 0% | | | 0% |
| Bremerton/Port Orchard | 5 | 8% | 8% | 1% | 6% | | | | | 0% | 1% | 0% | 24% |
| Skagit Conty | 8 | 0% | | | 0% | | 0% | | | 0% | | | 0% |
| NE WA/Canada | 9 | 0% | 0% | | 0% | | | | | | | | 0% |
| Snohomish County | 10 | 1% | 1% | 0% | 2% | | | | 0% | 0% | 0% | 0% | 5% |
| Seattle | 11 | 3% | 5% | 1% | 5% | | 0% | | 0% | 0% | 1% | 0% | 15% |
| Bellevue | 12 | 1% | 1% | 0% | 2% | | 0% | | 0% | 0% | 0% | | 6% |
| King County | 13 | 0% | 0% | 0% | 0% | | 0% | | | 0% | | | 1% |
| E WA/States to the East | 14 | 0% | 0% | | 1% | | | | | 0% | | 0% | 2% |
| South King County | 15 | 1% | 1% | 0% | 2% | | | | | 0% | 0% | | 4% |
| Vashon Island | 16 | | 0% | | 0% | | | | | 0% | | | 0% |
| Tacoma | 17 | 1% | 1% | 0% | 2% | | | 0% | | 1% | | | 5% |
| SE Pierce County | 18 | 0% | 0% | 0% | 1% | | | | | 0% | | | 2% |
| Federal Way/Auburn | 19 | 0% | 0% | | 1% | | 0% | | | 0% | | | 1% |
| Gig Harbor | 20 | 0% | 1% | 0% | 1% | | | | | 0% | | | 2% |
| W Pierce County | 21 | 0% | 0% | | 0% | | | | | | | | 0% |
| Thurston County | 22 | 0% | 0% | | 0% | | | | | 0% | | | 1% |
| Mason County | 23 | 0% | 0% | 0% | 0% | | | | | | | | 1% |
| Aberdeen | 24 | | | | | | | | | | | | |
| Grays Harbor County | 25 | | 0% | | | | | | | | | | 0% |
| SW WA/OR/CA | 28 | 0% | 0% | | 0% | | | | | 0% | | 1% | 2% |
| | | 0% | 0% | 0% | 0% | | | | | 0% | | | |
| Total | | 31% | 29% | 5% | 28% | | 0% | 0% | 0% | 1% | 5% | 1% | 100% |

This overall westbound chart displays the same trends as the other component charts. The large majority of origins were in Kitsap County. Zone 3, Kingston/Poulsbo, was the origin for 27 percent of all westbound traffic, while zone 5, Bremerton/Port Orchard, accounted for 24 percent and Seattle 15 percent. Destinations were in the Port Ludlow, Port Townsend, and Sequim/Port Angeles areas.

Table 3.12 All Traffic Eastbound

Total Trips = 3,501

| Total Trips = 3,501 | | Destination | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Origin | | <div><div></div><div>W Jackson County</div><div>Island County</div><div>Thurston County</div><div>Sequim/Port Angeles</div><div>Swain County</div><div>San Juan County</div><div>Sanborn County</div><div>San Diego</div><div>Yuba County</div><div>El Dorado County</div><div>San Bernardino County</div><div>San Diego County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino County</div><div>San Bernardino 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Similar to westbound traffic, the overall eastbound origin/destination chart is very similar to its component charts from the weekend and weekday. Origins for this traffic were Port Ludlow, Port Townsend, and Sequim/Port Angeles. Destinations were Kingston/Poulsbo, Bremerton/Port Orchard, and Seattle

The findings of the origin/destination survey are based on 9,419 weighted cases, in which all survey responses were included and weighted according to the methods described in the Weighting Results and Adjusting Data section of this report.

Trip Purpose

Question 4. “The primary purpose of this trip was transportation to/from:”

In addition to the differences in traffic between weekend and weekday trips and proximity to the bridge, the trip purpose reported by the survey respondents is a major determinant of trip characteristics. More than any of the other survey data, the trip purpose identifies a particular group of bridge users with specific travel patterns. For this analysis, ECO has grouped recreational, social, and personal trip purposes into a “leisure travel” category. ECO has not, however, grouped together travel to and from work with travel to or from a business appointment. This decision is based on the assumption that individuals traveling to and from their work site are commuters who have unique trip patterns that differ from those of travelers going to or from business appointments as part of their work day.

More than 60 percent of all weekend bridge travel can be categorized as leisure travel, which is defined by the survey respondents as travel for recreational, social, or personal purposes. Both recreational and social purposes individually accounted for over 20 percent of weekend trips but only 10 percent of weekday trips.

The major purpose for weekday travel was going to or from work, which accounted for 33 percent of all weekday trips and 24 percent of trips for both weekend and weekday combined. Weekday work trips accounted for the single highest percentage of all trips.

Work commuters are alone in their cars 77 percent of the time, while two-person trips accounted for the 48 percent of leisure trips. Those traveling to and from work also use the Hood Canal Bridge more often than those using it for other purposes. Thirty percent of those who were traveling for work purposes reported using the bridge five times per week, while 64 percent of leisure travelers reported using the facility once per week or less. Leisure travelers take ferries in conjunction with their trips across the bridge 32 percent of the time, somewhat higher than the 26 percent reported by work commuters.

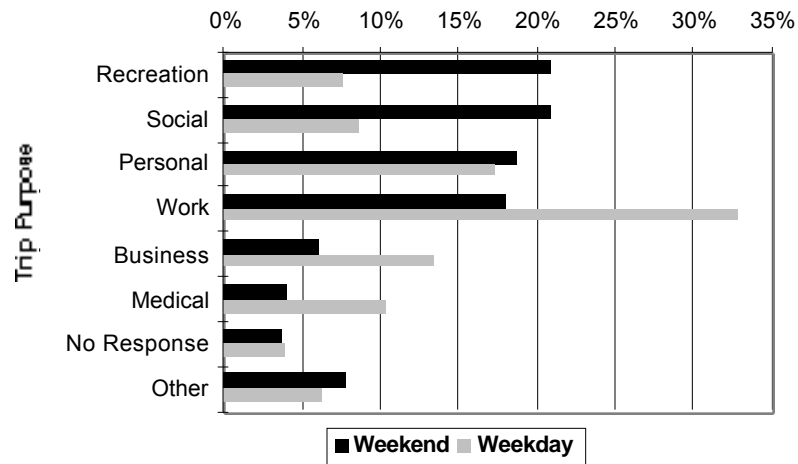
Table 3.13 Trip Purpose Summary Table

| | Work | Leisure |
|---|-------------|----------------|
| Percent of all trips | 24% | 50% |
| Percent of weekend trips | 18% | 61% |
| Percent of weekday trips | 33% | 34% |
| Percent of vehicles with 1 occupant | 77% | 30% |
| Percent making 1 or fewer trips per week) | 10% | 64% |
| Ferry use | 26% | 32% |
| Options – Reschedule | 13% | 43% |

For trips identifying work as the purpose, only 13 percent responded that they would be able to reschedule their travel. However, respondents selected the “reschedule” option 43 percent of the time for trips with a purpose other than work. This finding shows that the trips taken by the leisure travelers are more discretionary than those made by people who use the bridge to commute to work on a daily basis. Since the leisure trips make up a large percentage of weekend traffic, the volume differences between weekend and weekday traffic may diminish during the bridge closure as people making discretionary trips may opt to postpone their travel.

Respondents selecting a ferry across Hood Canal as an alternate route also differed by trip purpose. Question Number 11 was designed to identify existing alternatives that would be used rather than any potential services during the bridge closure. Of work travelers who said they would take a ferry if the bridge were closed, 45 percent wrote in that they would take a ferry across the canal. For leisure travelers, this option was only mentioned 14 percent of the time. Since the question did not give a Hood Canal ferry as an option, the number of people writing in that possibility under the “other” option is not significant. It is interesting, however, to consider the difference between work commuters and leisure travelers. The more frequent users of the bridge, those traveling to and from work, identified this as a preferred option even though it was not presented to them as such.

Figure 3.9. Percent of Trips by Purpose



Trip Frequency

Question 7. “How many times per week do you use the Hood Canal Bridge in this direction?”

Trip frequency varied primarily by purpose and the day of the week. As Figure 3.10 and Figure 3.11 show, the only case where the weekend travelers’ responses were greater than the weekday travelers’ responses was for one time per week or less. The comparison between work and leisure trip purposes shows a similar relationship where the response of leisure travelers was greater than work travelers for two times per week or less. Leisure travelers reported using the bridge once per week or less 63% or the time.

Figure 3.10. Frequency of Bridge Use

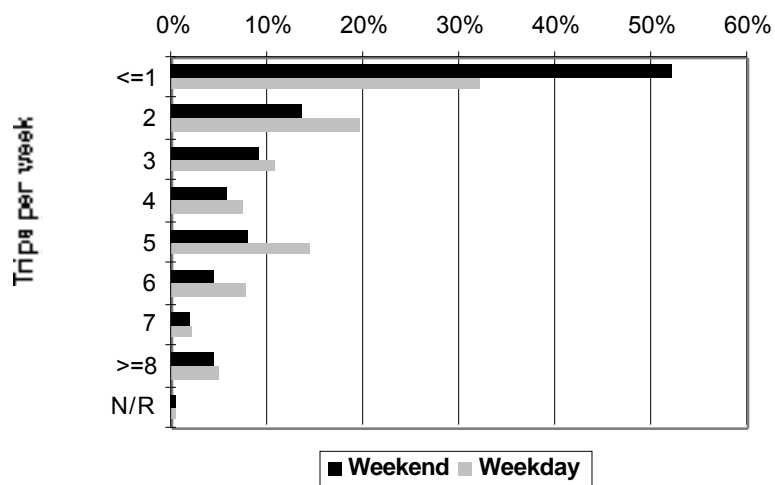
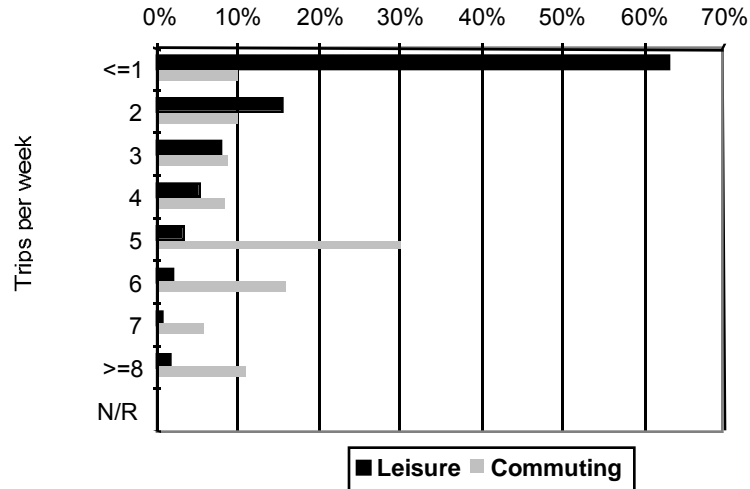


Figure 3.11. Frequency of Bridge Use by Purpose

Number of Occupants

Question 8. "Including yourself, how many people were in your vehicle?"

Travelers driving alone or with a single passenger make up the vast majority of trips across the Hood Canal Bridge. Lone drivers account for 45% of all trips, while trips with a driver with one passenger make up 39%. Two occupants (including the driver) was the most frequent occurrence for both weekend and leisure travel accounting for over 40% of trips in both cases. The percent of travelers reporting 3 or more occupants including the driver was higher for weekend and leisure traffic. Weekday traffic and trips to and from work were made almost exclusively by single drivers or drivers with a single passenger. The largest single group was work travelers driving alone, which occurred 77% of the time.

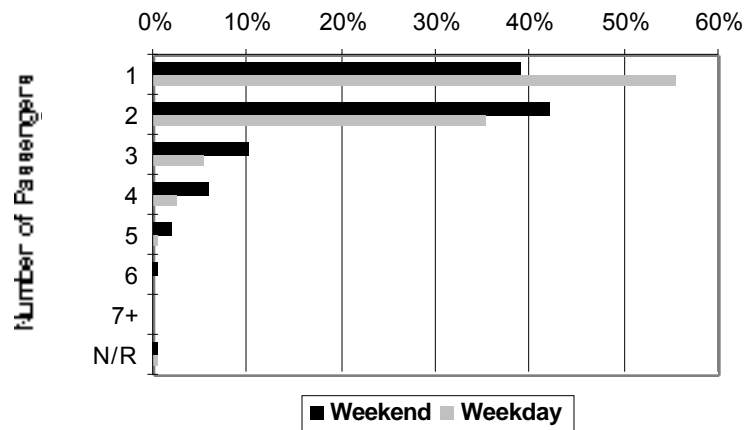
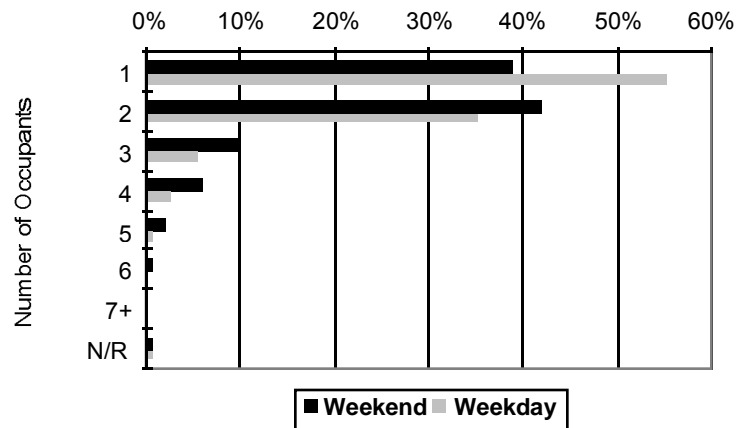
Figure 3.12. Total Occupants

Figure 3.13. Total Occupants by Trip Purpose

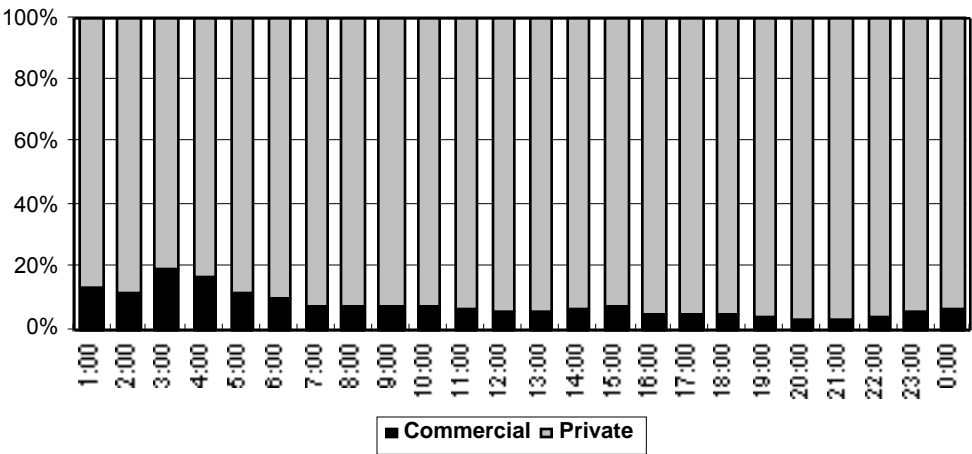
Vehicle Type

Question 9. "Please identify the type of vehicle you were driving."

- a. Automobile, passenger van, or pick-up**
- b. Motorcycle**
- c. Transit or tour bus**
- d. Recreation vehicle/motorhome**
- e. Single-unit commercial vehicle**
- f. Multi-unit commercial vehicle**
- g. Other**

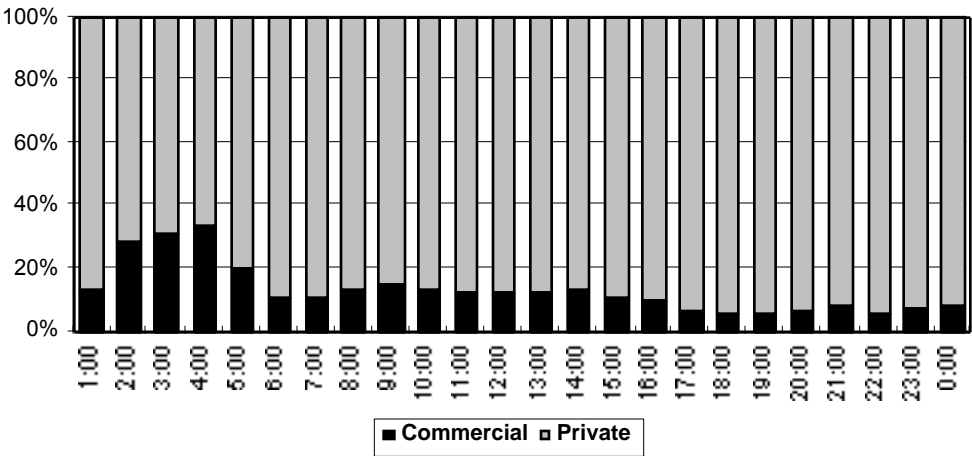
Automobiles, passenger vans and pick-up trucks made the vast majority of all trips across the bridge during the survey period. These personal vehicles accounted for over 90% of weekend, weekday, work, and leisure trips. The only other vehicle types mentioned in the surveys were Recreational Vehicles which made up 4% of leisure trips and commercial vehicles which made up 5% of weekend trips and 7% of work trips. Figures Figure 3.14 and Figure 3.15 show the relationship between commercial and private vehicles throughout the day using data from the traffic counters provided by WSDOT.

Figure 3.14. Percent of Commercial Vehicles to Personal Vehicles for Weekend Traffic



Source: Axle counts from WSDOT

Figure 3.15. Percent of Commercial Vehicles to Personal Vehicles for Weekday Traffic



Source: Axle counts from WSDOT

Commercial vehicles make up a larger percentage of traffic during the early morning hours, especially on the weekdays. This concentration of commercial vehicles may impact the alternative strategies chosen by the State.

Ferry Service

Question 10. “Did you take any ferries on this trip? If yes, please identify by circling the appropriate ferry/ferries below.”

Ferry use did not differ significantly between weekend and weekday traffic or between work and leisure trips. Overall, 31% of all trips included a ferry ride, and a similar percentage held for weekend, weekday, work, and leisure trips.

Table 3.14 Ferry Use Statistics

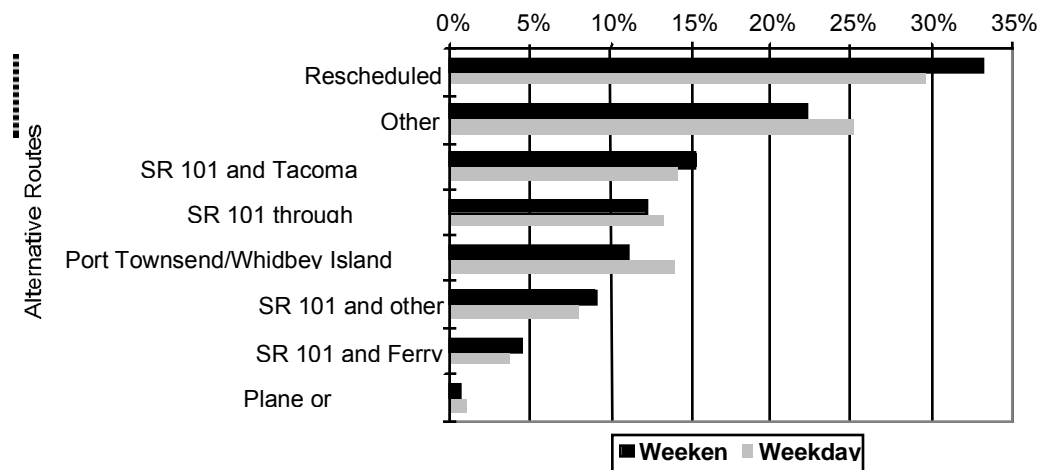
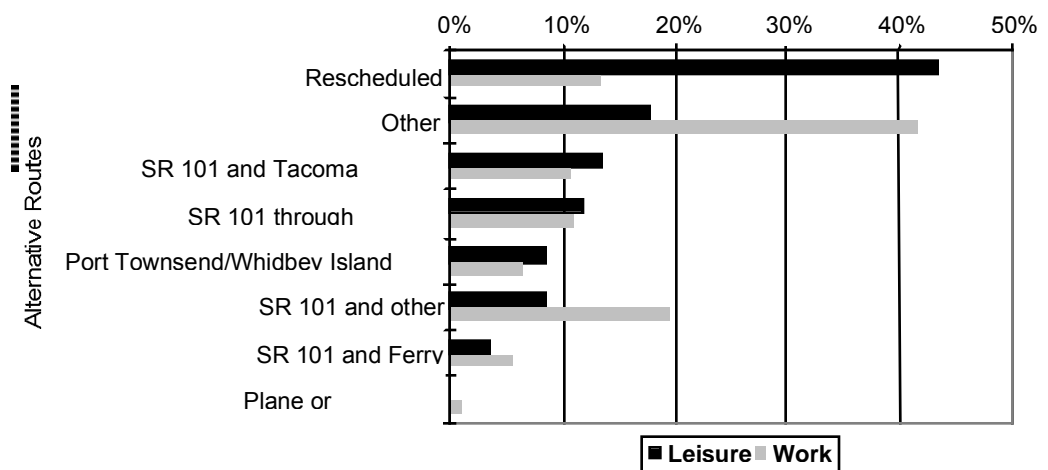
| | Percent of trips using Ferry |
|------------------|------------------------------|
| All Trips | 31% |
| Weekend | 33% |
| Weekday | 29% |
| Work | 26% |
| Leisure | 32% |

Of the travelers who reported using a ferry, 52% took the Edmonds/Kingston route and 32% took the Seattle/Bainbridge Island route.

Alternative Strategies

Question 11. “If you knew before you took this trip that the Hood Canal Bridge was going to be closed, what you have done?”

The alternative strategies selected by the survey respondents were fairly similar for weekend and weekday travelers, with weekday travelers less likely to reschedule their trip and more likely to choose an alternative not presented in the survey. The difference between work and leisure travelers is more dramatic and shows that only 13% of work commuters said they would be able to reschedule their trips while 42% selected alternatives not listed on the survey. These other options included temporarily relocating to the side of the bridge where they worked (13%), driving, using a route other than Hwy 101 (11%), losing their job/quitting (11%), canceling their trip (7%), and taking a Hood Canal ferry (6%). Forty-three percent of leisure travelers reported that they would have rescheduled their trip if the bridge had been closed, illustrating the discretionary nature of many of their trips.

Figure 3.16. Alternative Route Options Identified**Figure 3.17. Alternative Route Options by Trip Purpose**

IMPLICATIONS FOR MITIGATING EFFECTS OF BRIDGE CLOSURE

WSDOT should consider three major factors when determining how to mitigate for traffic during the bridge closure. The day of the week, proximity to the bridge, and trip purpose are all important elements that define the traffic volume and flow across the Hood Canal Bridge.

The origin and destination patterns among these areas are generally the same on weekend and weekdays. It does not appear, therefore, different alternatives for weekend and weekday travel are needed. However, the average weekend volume of 18,759 vehicles per day is significantly higher than the 14,915 vehicles per day on weekdays. If existing traffic patterns persist and alternative routes could be provided they would need to handle this additional weekend traffic.

Because the additional weekend volume largely consists of travellers making recreational, social, and personal trips, many of which are discretionary, however, any difference between weekend and weekday volume will be lessened by the number of travelers who choose to defer their trips during the bridge closure. If these “leisure” travelers opt to delay their trips, the existing difference between weekend and weekday volume will decrease, but this decrease will occur at a cost to the business owners near the bridge who rely on tourism sales as a major component of their business.


The video license plate survey provided registration information for the vehicles using the bridge. Ranking the cities and towns represented by these data per capita shows that the communities that will be most affected by a closure of the bridge are those in the immediate area. The origin/destination tables show consistent patterns to and from the cities and towns in close proximity to the bridge which leads to the same conclusion. The primary origins and destinations are in the Port Ludlow, Port Townsend, and Sequim/Port Angeles areas in the west and the Kingston/Poulsbo and Bremerton/Port Orchard areas in the east. If the effects of closure can be mitigated, alternatives should focus on linking these primary areas.

The group least able to adjust travel schedules is consists of commuters traveling across the bridge to and from work. Drivers in this group indicated that they used the bridge on average five times per week (in the direction identified on the survey) and only 13% would be willing or able to reschedule, so they will be highly affected by a bridge closure.


If alternative routes can be provided, they need to link the primary users of the facility who are traveling to and from the areas in the immediate vicinity of the bridge. They need to account for higher weekend volume made up of those travelling for recreational, social, and personal purposes as well as service the regular work commuters who utilize the bridge most often.

It is important to remember that the survey data reflect the existing uses of the bridge. The temporary closure of the bridge will substantially alter the relative costs of making a trip across the Hood Canal during that period. These changes in travel costs could significantly change the patterns of trip making. While it is important to understand the existing patterns of bridge usage, any strategies to mitigate the effects of the bridge closure should account for how travelers will respond to those future conditions.

APPENDIX A. ORIGIN/DESTINATION SURVEY INSTRUMENT




NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 742 SEATTLE, WA
POSTAGE WILL BE PAID BY ADDRESSEE

PACIFIC RIM RESOURCES
1109 1ST AVE STE 300
SEATTLE WA 98101-9965



Dear Recipient:

The Washington State Department of Transportation (WSDOT) is beginning a design project to replace the east half of the Hood Canal Bridge. The purpose of the project is to preserve this vital transportation link while minimizing impacts to users.

We have scanned randomly selected vehicle license plates and are mailing out survey forms to the registered vehicle owners. Your vehicle was one of those identified in the sample. If our records are incorrect and your vehicle did not pass the location on the noted date, please check the first question on the survey and mail it back. Otherwise, please take a few minutes to complete the survey and return it. No postage is necessary.

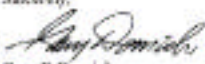
The replacement project requires a six to eight week closure of the Hood Canal Bridge in the year 2004. Prior to this closure, WSDOT will conduct an extensive public involvement effort to obtain input from users on the best times to close the bridge. As part of that effort, WSDOT has contracted with ECONorthwest of Seattle to perform an Origin and Destination Study. This video license plate and mailback survey will help the Department see if impacts can be mitigated and predict impacts to alternative modes of transportation and routes.

If you would like to be placed on a mailing list for information about the Hood Canal East-Half Replacement Project, a space has been provided below for you to include your name and address. Also below is an area for you to indicate if you would be interested in participating in future transportation surveys. This information will not be part of your survey record. Your answers will be anonymous and used for planning purposes only.

If you have any questions regarding the survey questionnaire please contact: Craig McDaniel, Project Engineer, Washington State Department of Transportation, 8293 Spring Creek Road, Port Orchard, WA 98367-8192. Telephone (360) 876-7540, Fax (360) 895-4743, E-mail: mcDaniel@wsdot.wa.gov.

Your prompt completion and return of the survey is greatly appreciated. On behalf of the WSDOT, we appreciate your participation in this survey, which is an important step in determining if it is possible to mitigate traffic options during the closure of the bridge.

Sincerely,



Name _____
 Address _____
 City _____ State/Province _____ Zip _____

Gary E. Denich
Olympic Region Administrator

I'm interested in participating in future transportation surveys YES ☐ NO ☐

----- CUT HERE BEFORE RETURNING SURVEY -----

Hood Canal Travel Pattern Survey

Dear Motorist:

The purpose of this survey is to obtain important information about travel patterns over the Hood Canal Bridge. The bridge will be closing for six to eight weeks in 2004 for the replacement of the east-half. Your completion of this survey will help the Washington State Department of Transportation (WSDOT) serve you better. After completing the survey, please refold with the Pacific Rim Resources address on the outside, tape at the bottom, and mail back to us postage-paid. Thank you.

Your vehicle was randomly selected while traveling on the Hood Canal Bridge on the date, time, and direction as shown on the other side of this survey above your name. Please have the driver of the vehicle answer the following questions about that specific one-way trip. To ensure your anonymity, you may cut off the panel with your name and address before mailing.

1. If none of the members of your household were traveling on the Hood Canal Bridge (as shown in the trip information on the other side of this survey right above your name) please check this box ☐ and return the survey to us uncompleted.
2. What was the city/town and state where you started the above referenced trip?
City _____ State/Province _____
3. Using the map below, please write the zone number in this box ☐ where you started the above referenced trip.
4. The primary purpose of this trip was transportation to/from: (circle one)

| | |
|--|---------------------------------|
| a. Work | f. A business appointment |
| b. School/college | g. A personal appointment |
| c. A social activity (visiting, going to movie, restaurant, etc) | h. Other (please specify) _____ |
| d. A recreational activity | |
| e. A medical appointment | |
5. What was the city/town and state where you ended this trip?
City _____ State/Province _____
6. Using the map below, please write the zone number in this box ☐ where you ended your trip.
7. How many times per week do you use the Hood Canal Bridge in this direction? (circle one)
Less than 1 1 2 3 4 5 6 7 8 or more
8. Including yourself, how many people were in your vehicle? (circle one)
1 2 3 4 5 6 7 or more
9. Please identify the type of vehicle you were driving (circle one)

| |
|---|
| a. Automobile, passenger van or pick-up |
| b. Motorcycle |
| c. Transit or tour bus |
| d. Recreational vehicle/motorhome |
| e. Single unit commercial vehicle |
| f. Multi unit commercial vehicle |
| g. Other (please specify) _____ |
10. Did you take any ferries on this trip?
Yes ☐ No ☐ If yes, please identify by circling the appropriate ferry/series below:

| | |
|---------------------------------|---------------------------------|
| a. Edmonds/Kingston | h. Port Townsend/Whidbey Island |
| b. Seattle/Bainbridge Island | i. Mukilteo/Whidbey Island |
| c. Fannyberry/Southworth | j. Port Angeles/Victoria, B.C. |
| d. Fannyberry/Vashon | k. Other (please specify) _____ |
| e. Southworth/Vashon | |
| f. Seattle/Vashon (pinger only) | |
| g. Seattle/Bremerton | |
11. If you knew before you took this trip that the Hood Canal Bridge was going to be closed, what would you have done?

| | | | | |
|---|---|--|----------------------------------|---|
| a. Taken Port Townsend/Whidbey Island ferry and continued on to my destination | | | | |
| b. Taken SR 101 via connections through either: <table border="0"> <tr> <td><input type="checkbox"/> Ferry/ferries (please specify) _____</td> </tr> <tr> <td><input type="checkbox"/> Tacoma Narrows Bridge</td> </tr> <tr> <td><input type="checkbox"/> Olympia</td> </tr> <tr> <td><input type="checkbox"/> Other (please specify) _____</td> </tr> </table> | <input type="checkbox"/> Ferry/ferries (please specify) _____ | <input type="checkbox"/> Tacoma Narrows Bridge | <input type="checkbox"/> Olympia | <input type="checkbox"/> Other (please specify) _____ |
| <input type="checkbox"/> Ferry/ferries (please specify) _____ | | | | |
| <input type="checkbox"/> Tacoma Narrows Bridge | | | | |
| <input type="checkbox"/> Olympia | | | | |
| <input type="checkbox"/> Other (please specify) _____ | | | | |
| c. Taken a plane or helicopter | | | | |
| d. Rescheduled this trip to a time when bridges were open | | | | |
| e. Other (please specify) _____ | | | | |

